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# RECOLLECTIONS OF THE MAMMALS OF NORTHWESTERN MINNESOTA

BY CHARLES EUGENE JOHNSON

## INTRODUCTION

The purpose of this paper is to present some personal recollections and certain notes from other sources on the mammalian life of a section of northern Minnesota about which, so far as I am aware, nothing of a general nature has been published. The principal localities referred to are in the southwestern part of Marshall county, in the vicinity of Warren, the county seat. I have, however, included notes or reports from other points in the same general section of the state, so that, with possibly one outlying exception which will be noted at the proper place, the outermost limits of the territory concerned may be roughly defined as the Canadian border on the north; an east to west line passing through Red Lake Falls, on the south; the Big Fork river (central Koochiching county) on the east; and the Red River of the North on the west.

With regard to notes from more distant localities in the section concerned I am indebted especially to my father-in-law, Warren E. Wood, and his late brother, Harry L. Wood. These men were experienced hunters and had a wide acquaintance with the territory about Warren, as well as with more distant parts. Warren E. Wood came to that section at practically the same time as my father and lived there to a considerably later date.

From the easternmost points of the territory covered I have obtained some notes from old friends, notably Henry Buring of Cass Lake, who formerly lived in the Big Fork country, and John Gjelhaug of Baudette;

and from two correspondents, John A. Borg of Baudette, and Elmer Olson of Carp, trappers in their respective districts.

A few other observations and notes for the more eastern points were secured personally in the summer of 1905, when, in company with my brother, Arthur M. Johnson, I made a canoe trip from Walker on Leech Lake to Baudette on Rainy River. This was before the railroad had been completed from Bemidji to International Falls, and many changes have taken place in that territory since that time.

My father arrived in the vicinity of Warren in the spring of 1881, as one of the early settlers, and his family joined him in June of the following year. During the next seven years we lived a mile and a half west of the village, on what will be referred to as the Lakin farm, where my father was foreman. The farm buildings were situated on the south bank of Snake river, a tributary of Red river.

In 1889 we moved to my father's homestead land about four miles northeast of the village of Warren and about two and a half miles north of Snake river. Here we lived until the fall of 1902, when we left that part of the state. This farm will be referred to as the homestead. Warren is situated on Snake river, about 18 miles east of Red river.

To anyone desiring a glimpse of the mammalian life of this section at a period some eighty years previous to the earliest date mentioned in the present notes, and as represented especially by the larger game and the fur-bearing animals, the journal of Alexander Henry, edited and published by Dr. Elliott Coues, will be found of interest. Many references in Henry's journal pertain to areas or localities covered by the present notes. The site of Warren village, as determined by Coues, evidently marks the point where Henry, on October 28, 1801, crossed Snake river on his way from his trading post near the mouth of Park river (North Dakota) to visit the Red Lake Indians.

## TOPOGRAPHY

The locality of the Lakin farm is within the Red River Valley proper, but our homestead lay about two and a half miles east of the Valley. The Great Northern Railway (Winnipeg line), in passing through Warren runs approximately along the boundary between the heavier clay soil of the Valley and the sandy loam of the land to the east. Westward, between the railroad and the Red river, excepting the woods bordering the Snake, the tree growth then existing was principally if not wholly the result of planting, consisting largely of windbreaks and a few farm-

yard shade trees, mostly of small size. Eastward from the railroad, excepting again the hardwood belt along the Snake, there was mostly "brush land," poplar groves fringed with willow thickets, dogwood, some choke-cherry, pin cherry, balm of Gilead (less frequent), etc. In places, especially along roadside ditches, were to be found occasional cottonwood saplings; in other localities there were a few scattered burr oaks of some size (perhaps six inches or more in diameter); and even small elm saplings were to be found in some of the poplar thickets between Snake river and the Middle river, the latter being the next tributary of the Red to the north of the Snake. The groves and thickets varied much in size and in age. The largest individual poplars in the oldest groves would measure perhaps ten to twelve inches in diameter.

On the wild land, the areas not occupied by groves and thickets were covered with a luxuriant growth of prairie grasses, principally bluejoint and arrow grass on the drier land, profusely sprinkled with characteristic prairie flowering plants. These prairie areas also varied much in extent and contained many large and small sloughs which in the spring and early summer often formed temporary ponds. Characteristic drainage features were the coulees. These had a general course from east to west, and in the spring break-up or during prolonged rains in summer they became streams of considerable volume. These coulees were of significance to some of the mammalian species and will be referred to again in the annotated list.

With the gradual clearing and breaking up of the land into fields and pasture land, the original wild life habitats became correspondingly reduced in extent, but when I left the territory in 1902 there yet remained numerous areas presenting the natural conditions; and while the larger game mammals had mainly disappeared, the smaller forms remained in practically undiminished numbers, for neither hunting nor trapping was carried on extensively by the farmers.

From my earliest recollections and up to the middle 'nineties, troops of Indians (Chippewas) were frequent sojourners in this territory, often setting up their tepees on our homestead and adjoining lands and remaining for varying periods in the early summer, digging the snakeroot (*Polygala senega*). These Indians undoubtedly lived largely on the small game, both birds and mammals, that abounded; but their influence was, I believe, so far as the quantity of such life was concerned, wholly negligible. The rabbits which were so plentiful in the poplar thickets probably constituted their chief source of meat. That the Indians for many years previous to this time had been making their annual visits

to this area was indicated by the many signs of their camping places which we noted, on the wild lands bordering our homestead section, in the form of clusters of little circular areas where their tepees had stood, in which the grass was more luxuriant or somewhat different in shade from that of their immediate surroundings.

## MAMMAL LIFE

In the list that follows it will be noted that certain species which doubtless occurred in the vicinity of Warren, the principal locality dealt with, are not mentioned. This is because the list includes only those forms which I had learned to recognize and the names of which were known to me at that time. Of introduced species the house mouse was plentiful about every farm yard; but at the time I left that section I had never seen a house rat, though this pest quite probably existed in the village.

**Sorex cinereus.** Common Shrew. During the years from about 1890 to 1902 I saw in the aggregate a considerable number on our homestead and the surrounding, territory. Many of these had been killed by some predacious species and then left untouched or only partly eaten. I have a specimen from the vicinity of Hallock, about 36 miles north of Warren, which was sent me in later years by the Rev. P. B. Peabody, well known ornithologist. There is the possibility, also that the Hoy shrew occurred, but if so, it passed unrecognized.

**Blarina brevicauda.** Short-tailed Shrew. This larger shrew was recognized also, and the specimens most frequently seen were, as in the case of the smaller shrew, such as had been killed by some natural enemy.

**Lasionycteris noctivagans.** Silver-haired Bat. In the summer months, I would occasionally kill or capture a little bat of blackish color with white tipped hairs that gave it a "frosty" appearance. These were doubtless of the species indicated.

**Euarctos americanus.** Black Bear. My first sight of a black bear happened in June, 1885, on our homestead. On the south side of the shanty in which we were living was a small patch of ground which my father had spaded up for a vegetable garden. In this patch my mother discovered the bear early one morning, where it was lying sprawled out as if enjoying a sun bath. About three years later, in the spring, my father again saw a bear on the homestead, and shortly afterward a bear's den was discovered at the same place, so it was assumed that this bear had wintered in it. The den was situated near the edge of a small slough, within a few rods of a poplar thicket, and was surrounded by tall grass and willow shrubbery.

In the latter part of September, 1889, during the threshing season, a black bear was killed by the Lakin farm threshing crew, on the north side of the Snake river, about half a mile from the farm buildings.

In the early 'nineties a young black bear, which had been captured somewhere in the surrounding territory, was kept chained up behind some store buildings in

the village, bordering a vacant lot where farmers when in town were accustomed to unhitch and tie their horses. This bear was a source of amusement to the school children, myself included. In the late fall it dug for itself a burrow which evidently was to be its winter quarters. One day my father had gone to the village and as usual unhitched his horses and tied them to the wagon on this lot, providing them with hay and feed. He had previously removed his buffalo fur coat, which he tossed carelessly to one side, on the ground, and when he was ready to put it on again it had disappeared. Looking about, somewhat puzzled, he noticed a few yards away a flattened, much trampled mound of earth and what appeared to be the mouth of a burrow. Approaching quickly and looking into the hole he saw his fur coat plugging the entrance; and as he took hold of it, found it apparently attached at the other end. By tugging gently the resistance was, however, gradually overcome and as he withdrew the coat he saw the face of a bear peering up at him. The animal had evidently been quick to take advantage of an opportunity to secure some excellent winter bedding.

Mr. Wood informs me that bears were occasionally seen on what was for years known as the Woodward farm, located about four miles northwest of Warren, at the time the new land was being broken—1881 and the years immediately following. One bear, he says, was killed on this farm. A large coulee which crossed the land formed a highway of travel, according to Mr. Wood, not only for bears but also for some of the other larger mammals that occurred.

In the early 'nineties a bear was seen on Sec. 5 of the Pembina farm (where Mr. Wood for some years was manager), the buildings of which were situated about a mile southeast of Warren.

About 1895, Mr. Wood, as a member of a hunting party consisting, in addition, of his brother Harry L., Charles Sager and Ernest L. Brown, killed a black bear near Twin Lakes, about 15 miles northeast of Stephen village. Mr. Wood killed the bear with a charge from his shotgun after it had been wounded by his brother. This bear was mounted by Mr. Brown, in whose taxidermy shop in Warren it remained for so ıe years, and where I saw it many times.

About 1894, Peter and Charles Turnlund killed a black bear in the township of Marsh Grove, Marshall Co. I am indebted to Charles Turnlund for particulars as to the locality.

**Procyon lotor.** Raccoon. The raccoon was found in the woods bordering Red river, but I do not recall ever having heard of its presence in the smaller woods along the Snake river, in the vicinity of Warren.

**Martes americana.** Marten. Three correspondents, John Gjelhaug, John A. Borg, and Elmer Olson, all agree that the marten has become scarce in Lake of the Woods and Beltrami Counties during more recent years (1923). Mr. Olson stated that he had not heard of any marten caught in his district "in the last 12 years."

**Martes pennanti.** Fisher. In 1923 I was informed by Mr. Borg that he had, some time previously, taken two specimens of the fisher about ten miles south of Baudette, in Lake of the Woods county. The species was rather scarce, he said, in his own as well as in adjoining counties.

**Mustela longicauda.** Weasel. The weasel was common in the areas about Warren. I did not at that time distinguish between the long-tailed species and the smaller short-tailed form (*M. cicognanii*). The latter may have occurred,

but the weasel which I frequently saw and occasionally shot or trapped was a large one and undoubtedly *longicauda*. On our homestead and the surrounding areas, especially in the late fall and winter, this weasel would often be seen running over the plowed fields, where in its white coat it was a very conspicuous object that caught the eye at a considerable distance. Open, deserted burrows of pocket gophers and ground squirrels, commonly found in and along the edges of the fields, were the refuges of these weasels when they were chased, and in these burrows I sometimes trapped them.

Occasionally during the summer months weasels attacked broods of chicks, yet considering the fact that our chickens received no special care or protection, but were allowed to roam at large and to roost wherever they pleased, our losses from this source were practically negligible. But we seldom overlooked an opportunity to kill weasels found around the barnyard buildings.

Early in July, 1900, I happened upon a weasel accompanied by a litter of young. They were traveling through a wheat field a short distance south of our homestead buildings. Giving chase, I managed after a considerable scramble to capture two of the young ones, which I carried home and placed in an improvised cage. They were a male and a female. They thrived and got along together in harmony. Then one morning in November I placed in their cage a butcher bird which I had shot, and when I looked into the cage again at noon both weasels were lying dead. Upon examining them I found a large wound in the lower flank of each one, the skin and flesh gnawed away. It was evident that they had killed each other, probably as a result of a fight over the bird; but the flesh of the bird itself had not been touched. The male was so much larger than the female that I was rather surprised to find that it, too, had succumbed.

**Mustela vison.** Mink. The mink occurreda long the Snake river; and also, I believe, along parts of the larger coulees where water remained for much of the year. Along the Snake river the habitat for mink was excellent, and no great amount of trapping was carried on. One point along this river where signs of mink were common and where my brother recalls seeing the animal itself, was the Pembina (farm) crossing, as locally known, about a mile east of the village, where we and others usually obtained the water for our stock during seasons when our wells gave out.

**Gulo luscus.** Wolverine. For Red Lake county Elmer Olson has informed me that he had heard that a wolverine was shot in the township of Bray about 1890. Mr. Gjelhaug and Mr. Borg, however, state that they have never heard of any wolverine seen or killed in their territory (Lake of the Woods county).

Reports of this species for any part of Minnesota, in past years, are scarce, and it seems probable that it now has been extinct in this state for some time. For that reason it appears worthwhile to mention here a report from territory outside the limits set at the beginning of this paper. Mr. Wood informs me that many years ago, probably in the late 'eighties or early 'nineties, he heard of a wolverine that had been killed in the vicinity of Brainerd, Crow Wing county, near the central part of the state. I have previously (Johnson, Jour. of Mam., Vol. 4; 54–55) mentioned a report from the northern part of St. Louis county in 1918.

**Lutra canadensis.** Otter. According to John A. Borg, trapper, otters occurred as late as 1923 in what is now Lake of the Woods County, but they were comparatively few.

**Mephitis hudsonica.** Skunk. Common in all the territory in Marshall county with which I was familiar. It was a frequent visitor on the premises both of the Lakin farm and of our homestead, where it usually put up under, but sometimes in, the outbuildings. As soon as we were old enough it became the duty of my brother and myself to keep the premises free from such visitors, and each summer a number of skunks were trapped, shot or otherwise disposed of in the performance of this eagerly accepted duty; but not always without more or less disastrous consequences to our persons. Other places being closed to them, these animals not infrequently gained entrance into the horse or the cow stable, and from certain retreats they found in these places it was rarely possible, as we boys operated, to dislodge them without exciting them to the highest degree, so that the result may be easily imagined. When this occurred in the cow stable we experienced more or less difficulty in getting the cattle to enter. The horses, on the other hand, when their stable was thus highly scented seemed less sensitive about it and, beyond a few suspicious snorts at first, showed no hesitancy about entering their stalls.

In addition to the skunks that visited the barnyard, others were met with quite regularly in the thickets, along the roadsides, and, in the harvest season, in the grain fields where they doubtless found much food, such as insects, field mice, etc., as well as shelter everywhere conveniently at hand in the shocks. One of the commonest sites of skunk dens was the higher coulee banks, where badger holes were available for free occupancy and cover and food conditions all that could be desired.

**Taxidea taxus.** Badger. The badger was common in the area of sandy loam northeast of Warren during the years we lived on our homestead. Although I knew of no farmers or others in our vicinity who made any general practice of destroying this animal, it did not seem to increase in numbers to any appreciable extent. In fact, at the time I left that section of the state I had an impression that the badger was less common than it had been in the previous years.

About 1894 my brother and I dug out two young badgers from a den on the banks of the large coulee situated half a mile north of our homestead. They were about the size of muskrats. At about the same time a neighbor's boy who lived a mile north of us had a badger which he had raised in captivity. This animal was practically as tame as a dog and followed the boy about the yard in much the same way.

Badger burrows were plentiful in and about the edges of the cultivated as well as the fallow fields, and while they were generally considered more or less of a menace to horses and cattle, which often ran at large, I do not recall ever hearing of any broken legs due to that cause.

A badger skin or two tacked up on the wall of a farmer's barn was a common sight in the years between 1890 and 1902. The skins were used sometimes for mitten covers, after they had been tanned in more or less crude fashion; and also for various harness accessories, especially to prevent chafing.

As definite records may be mentioned two badgers which my brother killed in the early summer, about 1895, on our homestead and an adult male which I killed on the land of our nearest neighbor to the south.

**Vulpes fulva regalis.** Red Fox. The fox was common in the areas northeast of Warren as well as in the districts extending westward to Red river. In the latter

localities the animal apparently found the extensive stubble fields much to its liking, and in late fall and winter frequently one would be seen by a person traveling by team. Early in the winter of 1898, in the township of Vega, ten or twelve miles west of our homestead, I drove past a fox lying curled up in a stubble field, within a stone's toss of the road.

On our homestead and the surrounding areas foxes were frequently to be seen, during the winter months especially, and their tracks and other signs were numerous. On the wild land east of our homestead, foxes would sometimes be seen sitting on top of the haystacks, singly or in pairs, and occasionally a team was permitted to approach remarkably near before they retreated. The animal was rarely hunted by our neighboring farmers.

**Canis latrans.** Coyote. This was a very common animal, particularly in the thicket areas northeast of Warren. In the practically treeless area of the Valley proper extending westward to Red river, coyotes were, so far as my personal observations extended, much less common. On our homestead and in all the immediately surrounding territory coyotes could be seen almost daily, or heard at nightfall, throughout the late fall and the winter. Frequently these animals would come into the farm yard on winter nights, and occasionally would approach quite near even during daylight hours. In the winter of 1901, on a very cold, moonlight night, I saw two coyotes come into the yard, apparently having designs on our dog, which had taken refuge on the porch and from that retreat was barking and snarling savagely.

One morning in the latter part of October, 1900, I came upon two coyotes within about fifty yards of our stable, while they were feeding upon the carcasses of some of their own kind which had been partly buried at the eastern edge of the poplar grove on the north side of the buildings.

Occasionally the coyotes were seen in pairs, but most often singly. My brother recalls that he saw three of the animals together one winter day, about 1894, just after sunset, at the eastern boundary of our homestead; and about 1898, I saw four moving about together, in the same locality. These are the largest numbers we ever saw in a "pack."

Despite the number of the coyotes and their near approach at times to the barnyard, our livestock, excepting possibly a few unnoticed chickens, never to my knowledge suffered from the attack of these little wolves; nor do I recall that any of the farmers on neighboring lands experienced any losses in this way. All of them had young stock of various kinds, including sheep. Our own cattle as well as theirs, and the sheep, were allowed to roam more or less at large and unattended, especially in the fall, but in no instance that I know of did any attacks on this stock by coyotes occur. As a consequence few of the farmers paid any attention to these wolves. Occasionally a farmer would shoot or trap one of them as an opportunity presented itself, but no systematic effort was made towards reducing their numbers. There was always a bounty of a few dollars (three to five) which served as an inducement for some individuals to carry a rifle in the winter time and watch for a chance to shoot a coyote. A farmer in the adjoining township killed more coyotes than did any other person I knew. He used three hounds, and occasionally brought in two or three specimens as the result of a day's excursion. In the later 'nineties, my brother recalls, an Iowa hunter carried on a coyote hunt for a few days in our township. One day he

brought in two of the animals in quick succession, taken in our immediate vicinity. He, also, hunted with dogs. The law required that the entire carcass be presented to the town clerk in claiming the bounty.

During the winter months when my brother and I tramped to school in the village, dusk ordinarily overtook us when we were about halfway home, and at that hour the coyotes usually began their evening serenade in the thicket areas southwest of our homestead, through which we had to pass. While we were smaller these weird performances caused us more or less uneasiness, and when the animals along our route became particularly energetic in this respect my father would come to meet us, sometimes carrying a lighted lantern. His repeated assurances that the coyotes would not molest us did not always sustain us completely.

A curious experience with coyotes was related to me by Frank Monroe, a well known and highly respected farmer living in the same township, about four miles eastward from our homestead. The main facts briefly stated are these:

Mr. Monroe about 1892 was returning home one night on foot from a point some miles east of his place when he heard coyotes begin howling rather excitedly in his vicinity. Soon he became aware that the animals were following him. At first he gave little heed to the matter, but the animals meantime had been coming closer and closer. As he walked rapidly on, some of them began coming in rather boldly behind him, and he therefore attempted to frighten them away by suddenly turning upon them, shouting and waving his arms.

At this the animals would retreat hastily a short distance, but would return as soon as he again was on his way. He continued this procedure for a time, but it seemed to excite the beasts and make them bolder rather than frighten them away; whereupon he began to grab up handfuls of the thick prairie grass by the wayside and, setting fire to them, thinking the traditional fire method would have the desired effect, but he soon exhausted his match supply without getting rid of the coyotes.

He was by now taking the matter more seriously and after each stop to frighten the animals off, had begun to run. These tactics he kept up until he reached a fence skirting the bank of the river (the Snake), and here he stopped to break off a rail to use as a club. But in the meantime another pack of coyotes, which he had been hearing in the distance, was coming nearer. His shouts and the racket of the coyotes were finally heard by his oldest son, Fred, who lit a lantern and hastened to meet him. The animals now disappeared in the darkness.

This account has been corroborated recently by Fred Monroe, who at the time of this occurrence was about twenty years of age.

**Canis nubilus.** Timber Wolf. I have no personal observations or reports indicating that the timber wolf occurred in the western part of Marshall county during the time we lived there; but most of the people in that section probably did not distinguish between the two kinds of wolves. In the more eastern parts of the county, the timber wolf was, however, well known to exist, and during the 'eighties and early 'nineties doubtless was to be found in the more densely wooded areas of all of the eastern half of the county. They were plentiful also, Mr. Wood tells me, in the country about Red Lake until quite recent years. He furnishes me the following incidents from that general region.

Ernest L. Brown was hunting and trapping in the territory around Thief Lake

in the 'nineties, and one day had shot a deer, which he hung up on the spot, intending to return for it the next day. When he arrived he found that the carcass had been pulled down and much of it devoured by what he judged from the tracks to have been a lone wolf. Distributing some poisoned bait about the carcass, which he left untouched, he came back the next day and found a very large timber wolf lying dead near by.

About the same year, at a logging camp near Red Lake, Mr. Wood saw the carcass of a large buck that had been killed by timber wolves. The dead animal lay in the sleigh tracks within about fifty feet of the door of the camp horse stable and had been killed just before the teamsters came out to feed their horses at about four o'clock in the morning.

In the country about Baudette, according to Gjelhaug, Borg and Olson, the timber wolf was still found in 1923 but was no longer common.

**Lynx canadensis.** Canada Lynx. According to Mr. Wood, a Canada lynx was killed about six miles southwest of Warren, in 1884. This is the only report concerning this species which I have for that general area.

In the territory around Red Lake, says Mr. Wood, lynxes were common; and one was seen in more recent years near his place on the Red Lake river, about eight miles east of Thief River Falls.

**Lynx rufus.** Wild Cat. I know of no reports of the wild cat for the northwestern section during the time that we lived there. Mr. Wood tells me that he personally had never seen or heard of a wild cat in that territory, and that while his intimate friend, Ernest L. Brown, obtained many lynx skins from the Indians at Lake of the Woods, there were never any wild cat skins among them. It appears, however, that the range of the wild cat has been extended northward into some of the more eastern parts of this northwestern section in later years.

**Marmota monax canadensis.** Woodchuck. I never saw a woodchuck in the territory about Warren, and never heard of anyone else who had seen one. Present reference is therefore to points farther east. Mr. Wood informs me that woodchucks were common on his farm east of Thief River Falls, Pennington county. In certain parts of Itasca and Koochiching counties I saw numerous woodchucks along the water courses my brother and I followed in 1905. Along the banks of the Big Fork river, especially, but also in other places where homesteaders had planted small vegetable gardens, numbers of the animals were to be seen in the late afternoons and evenings as we paddled silently by in our canoe. The owners were, practically without exception, absent for the summer months, and the little cleared patches of ground representing their gardens seemed to be mustering places for all the woodchuck population of the immediately surrounding forest. The planted vegetables that were making a brave struggle for survival, while appearing to have suffered somewhat from the visits of other animals also, such as deer and moose, had evidently not been the chief object of interest to the woodchucks or they would have been completely destroyed. It seemed to be rather as a play ground that these rodents found the little clearings to their liking.

**Citellus tridecemlineatus.** Striped Ground Squirrel. This animal, which was always called the "striped gopher" in that section, was abundant in many localities around Warren. In most short grass localities such as pastures, along the edges of fields, and the banks of coulees, the striped gopher was much in evidence throughout the early summer. On the wild prairie land eastward from our home-

stead these rodents also occurred, but were not so easily noticed until the slough grass had been cut. However, the cultivated areas contained relatively the densest populations.

**Citellus franklinii.** Gray Ground Squirrel. This was the "gray gopher;" it was found in many of the same localities as the striped form, but was less plentiful. On our homestead it was of rather common occurrence along the banks of the coulee and along the margins of the fields, where tall weeds, grass or scattered shrubbery formed suitable habitats. Deserted burrows of the pocket gopher were frequent dwelling places of the gray gopher as well as of the striped form, but it also made use of the many badger holes that were generally available. While more often living near the edges of the fields, these ground squirrels would also be found now and then living in the central part of a grain-field, where we would discover them during the harvest season. One fall, about September first, while shocking wheat, I observed one of these ground squirrels which had been disturbed by the passing binder, carrying a young one about, evidently in search of safer quarters. The young one had wrapped itself partly around its mother's neck and formed a compact bundle, securely held in place by the parent's teeth. Once, coming within a few feet of where I had seated myself on a bundle to observe her movements, the mother gopher stopped to scrutinize me, releasing her tooth hold on the young one and holding it in her forepaws in a strikingly human fashion as she squatted on her haunches.

**Tamias striatus griseus.** Chipmunk. The chipmunk was common along both the Snake and the Red rivers. All too frequently it fell a victim to our boyish pranks.

**Sciurus hudsonicus.** Red Squirrel. The red squirrel likewise was common along the Snake and the Red rivers. While plentiful in the hardwoods along the Snake, it rarely was seen in the poplar and brush thickets sometimes found but a few hundred feet away, on either side. It was an event of unusual interest, therefore, when one summer day, about 1895, my brother discovered a red squirrel in the poplar grove sheltering our homestead buildings, two and a half miles distant from the river woods.

**Glaucomys sabrinus.** Northern Flying Squirrel. The flying squirrel doubtless existed in the Red river woods (where it is now, according to Bailey,[1] represented by the subspecies *canescens*), but I have not been able to recall any definite facts in this regard, nor as to its possible occurrence in the woods along the Snake. For a point farther east Mr. Wood has informed me that on his farm on the Red Lake river, east of Thief River Falls, in more recent years there were two nests or families of flying squirrels (probably subspecies *sabrinus*), one in the timber along the river upstream from his buildings, the other in his threshing machine shed situated in a grove downstream from the buildings. A few of these flying squirrels were killed and identification made certain.

**Geomys bursarius.** Pocket Gopher. My recollections regarding this species refer particularly to our homestead and other territory northeast of Warren, beginning about 1890.

As the wild land northeast of Warren gradually was broken up and sown to small grains, the pocket gopher slowly invaded these fields, and on our own land

[1] North Amer. Fauna, No. 49, p. 44, 1926.

it became an interesting pastime (accompanied by strong parental encouragement) with us boys to trap the animals at every opportunity. Most of our efforts were at first limited to ground immediately surrounding the farm buildings, particularly the garden patch and the potato field. Later, as the earth mounds or "gopher piles" made their appearance with increasing frequency we extended our operations to any part of our land where the animals were found to be working. As a consequence we never suffered any damage from the pocket gopher that could in any sense of the word be called serious; but it was during the season when the grain was in the shock that such possibility came to our attention. Now and then a shock would be found into which the gopher had tunneled from below, had cut off nearly every head of grain from the interior bundles (wheat usually) and had stored its harvest in its underground chambers. The caps and other exterior bundles of the shock were generally left untouched, at least in their outermost parts, so that it was only upon thrusting the pitchfork into a bundle, or upon removing it, that one discovered that the interior of the shock was nothing but a mound of moist earth, in which the headless bundles stood firmly implanted.

Aside from ourselves I knew of no farmers in the territory about us who made any practice of checking the increase of the pocket gophers. Any losses that were incurred by their activities were accepted as a matter of course. Such losses, however, in the areas with which I was familiar, were quite insignificant in comparison with the yearly losses from other sources, such as adverse weather conditions, shelling out, the Hessian fly, lodging, and hailstorms, and consequently seemed trivial to the farmer.

**Castor canadensis.** Beaver. Within the last seven or eight years or less I saw an article in the Warren Register to the effect that beavers had appeared in that section of the state, at some point south or southeast of Warren, I believe, after a long period of years during which it had been unknown in that territory.

On the before mentioned canoe trip through the north central part of the state in 1905, I noted evidence of beaver at one point on the Big Fork river; and also on the Rapid river, in what is now Lake of the Woods county. In the latter locality we found a beaver dam in fresh repair, near which were two large cottonwood trees that had been partly severed by the animals. There were also more or less other fresh signs of their presence. At that time the beaver was quite generally supposed to have been exterminated in that part of Minnesota if not in the entire state.

**Microtus sp.** Meadow Mouse. Meadow mice were common in the cultivated as well as in the wild prairie areas. In the haying season we saw many in and about the sloughs and the coulees, and also in the grainfields, especially after the grain was in the shock. In the winter months they were met with in and around the straw piles. These large straw piles or "stacks" were chosen resting places of the snowy owl, a common winter sojourner, and few were the cold, clear winter mornings when one of these owls could not be seen perched upon the highest point of a straw stack. Perhaps meadow mice were the attraction which brought them there.

One harvest season, about 1896, the meadow mice were unusually abundant in a barley field on our homestead. The season was a very rainy one and it was necessary for us to spread out the shocks to dry to prevent the grain from sprouting. One day we noticed that practically every barley shock contained a number

of field mice. I decided to kill as many of these mice as I could and in the space of about two hours killed 86 by actual count. As I had only a stick with which to strike them down as we pulled the shocks apart, many of the mice escaped.

**Ondatra zibethica.** Muskrat. My personal acquaintance with the muskrat was restricted mainly to the area about our homestead, though the species doubtless was common in many localities along Snake river and other places. In certain parts of the larger coulees, there were year round pools of water surrounded with rank growths of marsh vegetation, and in such places little colonies of muskrats were usually to be found.

One fall in the late 'nineties I discovered an adult muskrat hiding under the hay in a manger in the cowstable. We knew of no place from which it might have come except the large coulee half a mile to the north. My brother recalls that one fall he found a muskrat hiding in a wheat shock near the southwestern corner of our homestead.

Along Red river the muskrats were very plentiful in places. On the land of Andreas Tonderum, in Big Woods township, was a certain pond where my brother had especially favorable opportunities to observe these animals. In the fall, before the pond was completely frozen over, the muskrats would come out on the ice in such numbers that the surface seemed to be covered with them.

**Zapus hudsonius.** Jumping Mouse. This species was common in many areas northeast of Warren. Every summer, during the haying season especially, I would see a number of these little mice. I noted them most frequently in the dry sloughs and coulees on our homestead, and on the prairie land where much of our haying was done.

Frequently, too, jumping mice got into our wells along with other mice, toads and salamanders.

**Erethizon dorsatum.** Porcupine. My wife tells me that about the middle of September, 1910, a porcupine appeared in the village of Warren, where it was discovered one morning in a tree in the yard of Mr. A. P. Frank, a well known resident of Warren for many years. Mr. Wood informs me that in the year of the great Pitt or Baudette fire (1910) he killed a porcupine on the prairie east of Thief River Falls. In its digestive tract was "a mass of tapeworms." Mr. Wood was of the opinion that this porcupine had been driven out of the woods by the fire and had continued its aimless wonderings.

**Lepus americanus phaeonotus.** Snowshoe Rabbit. The snowshoe rabbit was abundant on our homestead and in all the brush country east and northeast of Warren. My brother found the species common also along Red river; but there may be a question whether it was the same subspecies, since Bailey[2] found specimens from Grafton, N. D., to be nearer to the typical subspecies (*americanus*).

The numerous poplar-willow thickets and groves with their tangle of ground cover formed ideal habitats for the snowshoe rabbit, and hunting had no appreciable effect on its numbers, in our own territory.

In the winter of 1897, as nearly as I can place the year, the snowshoe rabbits in an area immediately adjacent to our homestead were more numerous than I had ever before seen them, there or elsewhere. Late one afternoon during that winter I went out to secure one for a high school physiology class in the village, and was

[2] North Amer. Fauna, No. 49, p. 139, 1926.

immediately impressed by the unusual number of rabbits in the edge of our neighbor's thicket. As I pushed a little farther into this thicket their numbers seemed to increase, the animals darting in all directions; without moving from my tracks I counted fifteen in sight at the same time. The whole grove seemed alive with them. Not long thereafter the population in the particular thicket referred to had become practically normal again.

**Lepus townsendii campanius.** Jack Rabbit. Common in all the areas around Warren, and westward to the Red river, the limit of my personal observations. It was confined almost wholly to the cultivated lands, extending its local range as the wild land was gradually cleared and broken up into fields. The species was still common when I left the section in 1902, and reports received later indicated that its status was apparently not much changed, as late as 1919, at least.

I have no recollection of the jack rabbit for the period during which we lived on the Lakin farm, and the species evidently came in gradually and more or less unnoticed from the larger cultivated areas to the west and south of us.

While the jack rabbit was usually found in or along the margins of the grain fields, both in winter and in summer, little was seen of it in the summer months after the grain had reached a few inches in height. Occasionally, however, when the young had become of sufficient size, little family groups might be seen feeding and moving about leisurely in the distant parts of some green field, their forms barely visible above the top of the grain. I knew of no one who hunted the jack rabbits because of any damage they might have been thought to do. In fact I never in that section heard any one complain of any damage to crops from that source.

During the winter months jack rabbit hunting was one of the favorite sports of the farmers' boys in our district, though inroads on the species by this agency were negligible.

A very limited but regularly sought feeding ground of the jack rabbits living closer to our homestead buildings was our garden patch, where cabbage stalks, leaves and a variety of other vegetable remains were soon discovered by the animals on their nightly foraging excursions. The number of these jack rabbits present at any one time was never, so far as I can recall, more than three or four at most.

In hunting the jack rabbit, although it was frequently shot from the sleigh when we were hauling wood or hay, for example, the practice was generally to go on foot or on skis. An especially favorable time for locating the animals, as we hunted, was just after a blizzard. Soon after sunrise on the morning following the first night after such a blizzard had died down, the lying-up places of the jack rabbit could be seen at a considerable distance as the horizontal sunbeams fell upon the little heap of snow that had been excavated by the animal in making its form. In this form the rabbit sometimes lay so that the topmost part of its head and back, its eyes and the edges of its flattened, black tipped ears were all that could be seen, even after one had approached within a few yards of the animal. At other times it might lie several inches below the surface and could not be seen until it suddenly darted out almost from under one's feet. One of the best situations in which to find the jack rabbit was in the great billowy snow drifts piled along the weedy edges of fields.

A characteristic of the jack rabbit which we early learned to take advantage of

was its habit of returning to the same form every day, if it was not disturbed while lying in it. Having once been frightened from its bed it would not return to the same spot.

One spring a dog we owned, which was much given to chasing rabbits, started a jack rabbit in a newly sown field bordering the north bank of the coulee on our homestead. I was watching the chase, and when the animals had run about half a mile I saw the jack exhibiting signs of distress. It began running in circles, and the dog was gaining distance. The circles became rapidly smaller, when suddenly the rabbit disappeared into the earth. The dog, quite exhausted, lay down. As the chase had ended quite near me I hastened to the spot and found that the rabbit had entered a shallow badger hole. I quickly drew it forth, but it was dead. It proved to be a pregnant female, and on cutting it open I found the young, four in number as I recall, at approximately half term. The teeth of the dog had not touched the animal; it had simply been run to death.[3]

In the early spring, when the snow was largely gone from the plowed fields, the white, strikingly conspicuous form of the jack rabbit was frequently to be seen lying in its bed on a large patch of black ground, and visible at long distances, when only a few rods away, at the weedy margin of the field, there still lay considerable drifts of snow offering a background of concealment theoretically of the kind it should have selected. Few such self advertising individuals escaped our bag.

**Cervus canadensis.** Elk. I personally never saw any wild elk in Northwestern Minnesota. However, when we first came to live on our homestead, in 1890, I saw many elk antlers which farmers had picked up here and there, on or in the vicinity of their lands, and had placed around flower beds or in other situations about their yards for ornamental purposes.

Warren E. Wood informs me that he hunted elk in the eastern part of Marshall county and in Kittson county in 1884 and some years later. By the early 'nineties these animals were practically all gone from that territory. They were still to be found, however, some years later in the vicinity of Lake of the Woods. With regard to some elk hunting experiences of Mr. Wood, I will quote him as follows:

"I shot a spike horn bull elk in northeastern Marshall county, in or near Lincoln township. There were two cows and two calves or yearlings in the band. We got one cow and the bull. I have followed the trail of bands of elk in that country that made a good path through 18 inches of snow. They numbered not less than 20. That was late December, about 1887. I was told that by March the bands were bunched together and would contain as many as 50. The locality was from the most western sand ridges [beach of Glacial Lake Agassiz], east some 20 miles to the beginning of jackpine and muskegs, with tamarack, and north and south through Marshall and all of Kittson counties. Ray Palmer and I went into camp with a bunch of Indians in the Roseau swamp country—that was eastern Kittson county—at about 3 p.m. one June afternoon. By sundown one Indian had killed 3 elk. They had Hudson Bay guns. These were just the old musket. They cut off a piece of lead from a small bar and with camp ax hammered it till it would slip up and down the barrel without sticking. That, with powder and a

[3] See also Johnson, Journ. Mamm., vol. 6, pp. 245–246, for account of a swimming jack rabbit.

wad of gunny sack and a cap fixed them up. You will know about how close to the game they had to be to kill it. The country was park-like. This was in 1885."

**Odocoileus virginianus borealis.** White-tailed Deer. Personally I never saw any deer in the vicinity of Warren. However, about 1897 I found a well preserved antler of an adult buck in a poplar grove situated about a hundred yards southeast of our house on the homestead. I also saw from time to time antlers that had been picked up by others in the areas northeast of Warren. In the 'eighties according to Mr. Wood, deer were occasionally seen on the land of the old Woodward farm.

In the eastern part of Marshall county deer were common and were here regularly hunted by the village sportsmen, up to about the time I left this section. But even at the present time,I am informed by Charles Turnlund, living in the eastern part of McCrea township, stray deer are occasionally seen in his vicinity.

**Alces americanus.** Moose. About 1897, as near as I can recall, my uncle, Alfred Horgen, saw a stray moose which ran through his pasture, about 7 miles northeast of Warren. The animal ran past his herd of cattle, clearing the fence with ease, and continued on its way. Such occasional strays are not unheard of even in very recent years, for Mr. Turnlund further informs me in his letter of Dec. 6, 1929, that three years ago one of his neighbors saw a large moose somewhat farther east, but in the same township.

In the spring of 1905, Mr. Woods tells me, a bull moose swam across Red Lake river on his farm about eight miles east of Thief River Falls, Pennington county. This was the last moose he saw in that vicinity.

Moose were hunted in northeastern Marshall county until about 1905–6. On a visit to Thief Lake in the fall of 1909 I learned that few moose then remained in this immediate territory. One of the sons of the family with whom I stayed had shot more than forty moose in that vicinity in preceding years. So long as moose were fairly common in northeastern Marshall, and southeastern Kittson (or what later became Roseau) counties, these were the districts where the Warren hunters usually sought this game.

In the museum of the University of Kansas are a number of specimens of Minnesota moose obtained in 1890 and 1891 by the late L. L. Dyche. Some of these specimens were taken near Lake of the Woods, others near Thief Lake. Mr. Wood, with whom Mr. Dyche made his headquarters, and who hauled the Thief Lake specimens to the railroad, informs me that these particular specimens were shot by Ernest L. Brown, Dyche's guide on this trip, on Moose Creek, which enters Thief Lake on the east shore. At that time, says Mr. Wood, this creek was bordered, near the lake, by a marsh about half a mile wide. On the north side of this marsh was a tamarack swamp, while on the south side the tree growth consisted of a mixture of aspen, birch, etc. Mr. Wood visited this locality again in 1921, and he tells me that conditions had been so changed by drainage, clearing of land and farming activities generally that he was unable to identify the locality where the moose were killed years before.

**Rangifer caribou caribou.** Woodland Caribou. Until the late 'nineties, according to Mr. Wood, caribou were common in the territory south of Lake of the Woods, and as far eastward as Red Lake and beyond. In the winter of 1895 he had a logging camp on Tamarack river, entering Upper Red Lake on the east shore. The caribou at that time, he tells me, "came south in large droves, follow-

ing the marshes, during the winter. . . . We bought sleighloads of moose and caribou meat from two trappers located about 15 miles from us, and some 25 miles northeast of Upper Red Lake, in the Big Fork river country. We sent teams after it and gave them three cents a pound for the meat. The caribou meat, however, we did not fancy. It had a rank taste of peat or moss, and we had difficulty in getting some of the men to eat it. The trappers told me that one drove of caribou of at least 500 head went through near their camp."

These trappers worked for Mr. Wood during the log drive in the spring. They were of the opinion that the caribou came down from the north during late January and early February, following the muskegs and traveling in bands numbering from 25 to 100 head, with occasional larger ones like that above mentioned.

A number of caribou specimens from Minnesota are mounted in the Museum of the University of Kansas. As in the case of the moose, these caribou also, according to Mr. Wood and the records of the Kansas Museum, were secured for the late L. L. Dyche by Ernest L. Brown. They were shot in the northern part of Lake of the Woods County. Mr. C. D. Bunker, Assistant Curator in charge of the mammal collection at Kansas University, has kindly furnished me the date from the Museum's records as March, 1891, when these caribou specimens were taken.

About 1908 I learned from a friend that a band of caribou was then living in a certain muskeg area north of Red Lake, and that the animals remained there the year round. In 1912 these caribou were apparently still in the locality, but between the Indians and the white settlers of the adjoining territory their continued existence was considered to be but a matter of a few more years.

**Antilocapra americana.** Pronghorned Antelope. Records or reports of the pronghorn within the boundaries of Minnesota in past years are few. For that reason the following report seems worthy of mention. I have this statement from Warren E. Wood, who got the report direct from the men who saw the animals.

Mr. Wood's first night in the Red River Valley was spent on what was for many years, and perhaps still is, known as the Keystone Farm, about 8 miles west of the present village of Euclid, in northern Polk county, and about 18 miles south of Warren. An uncle of Mr. Wood's, also named Warren, was then the manager of this farm. On the day of Mr. Wood's arrival two of the owners of the farm returned after dark from an all-day trip to the junction of the Red Lake river with the Red, there being at that time, according to Mr. Wood, no city of Grand Forks, and very few settlers in that direction. These two men reported that they had seen "a bunch of antelope" on their trip that day. The date was about July 1, 1881.

The men who reported this observation could have had no reason to deceive, and neither is there any reason to think that they did not know the animal when they saw it; therefore this report would appear to be entirely authentic.

**Bison bison.** Buffalo. Remains of the buffalo in the form of skulls and other bones, and even horn sheaths, were to be found generally distributed over the wild prairie lands east, northeast and north of Warren. Various remains were frequently unearthed in the plowed fields; and in one of our own fields where such remains were turned up I found a perfect arrow head and a stone mallet, which may well have had some past association with the buffalo bones in question.

My brother reminds me that when we first came to live on our homestead, in 1889, there were many bison remains, including skulls, parts of skulls and other

bones, lying partly imbedded in the ground, scattered over the prairie land extending eastward from our shanty. Also on the sections immediately to the east of our quarter, where we put up our hay, various skeletal parts were encountered at times by the mower. On these areas, too, were to be found certain old signs of buffalo days such as traces of former trails and of wallows.

On our homestead, at the edge of a small slough I found, about 1896, a buffalo skeleton that was practically complete, except for the skull, which was lacking. A few rods to the south, within our pasture area, lay two large buffalo skulls, and one of these possibly belonged to the skeleton in question.

My father related to me that one day in the spring of 1881, while he was employed on the old Woodward farm, before mentioned, and was breaking new land at some distance from the buildings, he saw a small herd of buffalo which happened to come rather close to where he was working. The animals apparently were following some accustomed route. The sloughs at that season contained considerable water, and my father described the buffalo as taking fright at the sight, or wind, of the men and rushing through the water at a remarkable pace, surrounded by a cloud of spray. So far as I have been able to learn these were the last buffalo seen in the territory around Warren.

With respect to what was probably the last buffalo killed in the vicinity of Warren, I am indebted to Mr. Wood for the following account.

"Charles Wentzel, who squatted on land just below where Warren is, before the land was surveyed and before the Great Northern railroad [Crookston-Winnipeg line] was built, and who was a trapper all through that country for some years before, claimed to have killed a buffalo just west of Warren in 1878, and I have no doubt that he did."

As regards points farther east, Mr. Wood informs me that he has found buffalo remains on his land bordering Red Lake river, eight miles east of Thief River Falls, in Pennington county. And from Henry Buring, in a letter of Feb. 23, 1923, I have the following note: "About 8 or 9 years ago, the Great Northern Railway was putting in a new bridge on the outskirts of Cass Lake, Cass county. In digging in the creek bed the men found six or seven well-preserved buffalo skulls with horns. So we must have had them in the timber country here also. Other bones besides the skulls were there, too. The animals probably got mired."

*Roosevelt Wild Life Station, New York State College of Forestry, Syracuse.*

# SIX NEW RACCOONS OF THE PROCYON LOTOR GROUP

By E. W. Nelson and E. A. Goldman

The raccoons of the *Procyon lotor* group, with a transcontinental range from southern Canada to Panama, and including several distant islands, are among the most familiar and characteristic of American mammals. More than 20 species and subspecies have already been described, but the distribution areas and relationships of the forms have hitherto been very imperfectly known. Pending the completion and issuance of a comprehensive treatment of the group, undertaken by the authors, it seems desirable to publish descriptions of additional forms that appear to warrant recognition.

In determining relationships and tracing the distribution areas of subspecies inhabiting the eastern United States it becomes necessary, for precision, to fix the type locality of *Ursus lotor* Linné. This species was assigned to "Habitat in Americae *maritimis*." Linné's short description apparently is based largely upon the accounts of the animal by Peter Kalm, as he observed it in Pennsylvania and New Jersey, and the type region is currently regarded as eastern United States. Kalm (Travels into North America [English edition], Vol. 1, 1772, pp. 76, 360) records the species from Germantown and Philadelphia, and from the village of Raccoon, New Jersey, which according to the translator was considered "a place which is properly its native country." The village of Raccoon of Kalm's time, at or near the present town of Swedesboro, Gloucester County, New Jersey, is selected by us as the type locality of *Ursus lotor* Linné.

For the use of material generously loaned to supplement the large collections in the U. S. National Museum our thanks are due to Dr. Thomas Barbour, Museum of Comparative Zoology, to H. E. Anthony, American Museum of Natural History, to S. C. Simms, and Dr. Wilfred H. Osgood, Field Museum of Natural History; to J. D. Figgins, Colorado Museum of Natural History, and to Francis Kermode and W. A. Newcombe, Provincial Museum, Victoria, British Columbia.

## DESCRIPTIONS OF NEW SPECIES AND SUBSPECIES

### **Procyon gloveralleni,** sp. nov. Barbados Raccoon

*Type.*—From island of Barbados, Lesser Antilles, West Indies. No. 18591, male young (permanent premolars not quite fully in place), Museum of Comparative Zoology, collected by Sir Francis Watts, 1920.

*Distribution.*—Known only from the island of Barbados.

*General characters.*—A small, dark species, with a short, delicately formed skull and remarkably heavy dentition. Similar in color to *Procyon minor*, of Guadeloupe Island, Lesser Antilles, but sides of body and limbs darker, owing to more numerous black-tipped hairs (black-tipped hairs thinning out and sides of body and limbs more grayish in *minor*); cranial characters, especially the much heavier dentition, distinctive. Contrasting with *P. maynardi*, of New Providence Island, Bahamas, in darker general color and widely different skull.

*Color.—Type.*—Upper parts in general near light ochraceous buff (Ridgway, 1912), most intense on nape and shoulders, rather heavily overlaid with black, becoming lighter buff, less obscured by black on sides of body and limbs; top of head buffy gray, mixed with black; face with solid black mask and usual white markings; the upper surface of muzzle black to nose; sides of muzzle, lips and chin white; under parts thinly overlaid with buffy grayish; throat patch brownish black, thinly overlapped by ochraceous buffy hairs, here reversed forward as usual in the group; ears buffy grayish with black patches at posterior base; ankles dusky all around; feet soiled buffy whitish; tail with four narrow black rings and a black tip alternating with light ochraceous buffy rings, the subterminal black ring and tip nearly coalescent.

*Skull.*—Similar in general to that of *P. minor*, but shorter, more delicate in structure; braincase narrower, more evenly rounded; frontal region relatively broader and flatter; zygomata more slender; palatal shelf narrower; dentition very much heavier throughout, the individual teeth very similar in sculpture, but crown of upper carnassial longer than broad, a condition unusual in the group. Compared with that of *P. maynardi* the skull differs in about the same characters as from *minor*, except that the palatal shelf is decidedly broader.

*Measurements.—Type.*—Hind foot (dry skin, c.u.) 89 mm. *Skull* (type): Greatest length, 94; condylobasal length, 89.2; zygomatic breadth, 53.4; interorbital breadth, 18.7; least width of palatal shelf (between last molars and interpterygoid fossa), 13.6; upper toothrow, exclusive of incisors (alveoli), 37; upper carnassial, crown length, 9.8, crown width, 9.

*Remarks.*—Dr. Glover M. Allen (Mammals of the West Indies, Bull. Mus. Comp. Zool., vol. 54, no. 6, 1911, p. 221) recorded the occurrence of raccoons in Barbados and referred to Griffith Hughes (The Natural History of Barbados, 1750, p. 66) who, writing in the middle of the 18th century, mentioned a law of the island providing a bounty for destruction. In the absence of specimens for study the animal was tentatively referred by Allen to "*Procyon? cancrivorus* G. Cuvier." Subsequent efforts by him to obtain representatives resulted in the collection, in 1920, of the young individual here made the type of a new species bearing his name.

The type specimen was so young that the permanent premolars and canines, while well advanced, are not in full functional position. The first premolars, both deciduous and permanent, are absent in both jaws, an abnormality observed elsewhere only in the large-toothed form inhabiting Saint Simon Island, Georgia. There is no evidence of any abnormal shortening of the skull. While such scanty material affords an unsatisfactory basis for a new species, comparisons with specimens of other forms of similar age indicates no very close relationship to any of them. The general form of the skull, especially the reduction of the postorbital processes of the frontals, shows alliance to other West Indian and Florida raccoons rather than to those of the Middle American mainland.

## **Procyon lotor hirtus**, subsp. nov. Upper Mississippi Valley Raccoon

*Type.*—From Elk River, Sherburne County, Minnesota, No. 187926, male adult, U. S. National Museum (Merriam collection), collected by Vernon Bailey, March 4, 1886. Original No. 161.

*Distribution.*—Upper Mississippi and Missouri River drainage areas from the eastern slopes of the Rocky Mountains east to Lake Michigan, and from southern Manitoba south to Oklahoma.

*General characters.*—A large, dark subspecies, with long, full, soft pelage, usually suffused with ochraceous buff; skull with high, narrow frontal region, and weak or obsolescent postorbital processes. Similar to *Procyon lotor lotor* of the eastern United States, but much larger; pelage longer and usually more suffused with ochraceous buff. Size about as in *Procyon lotor fuscipes* of Texas, but color darker, the pelage much longer and denser, more suffused with buff instead of grayish, the light subapical zone of hairs over upper parts less extensive and permitting the under color to show through; skull differing in slight details.

*Color.—Type:* Upperparts light ochraceous buff, becoming nearer ochraceous buff on nape and across the shoulders, rather heavily overlaid with black; top of head mixed gray and brownish black, giving a grizzled effect; face with white markings and black mask usual in the group, becoming brownish along median line; underparts in general thinly overlaid with light ochraceous buffy hairs only partially concealing the dense brownish under fur; throat patch brownish black; ears creamy white, with black patches at posterior base; limbs similar to under parts, becoming whitish on feet, but dusky markings present near heels extending down about half way over median portion of metatarsus; tail with the usual annulations and black tip, the light rings ochraceous buff, and the narrower dark rings (five in this specimen, varying from four to six in others), consisting of black-tipped hairs concealing underlying buff; dark rings less conspicuous and light rings assuming a lighter tone on under side.

*Skull.*—Very similar to that of *P. l. lotor* in general form, but much larger, more massive; braincase usually more tapering anteriorly, the sides of frontals diagonally below and behind postorbital processes less deeply indented or constricted; postorbital processes of frontals weakly developed, or obsolescent, as in *lotor*. About the same in size and most important details as *P. l. fuscipes*, but interorbital and postorbital regions usually narrower; frontal area similarly high, but usually less flattened, with a narrower, more distinct, V-shaped, median depression.

*Measurements.—An adult male from Fargo, North Dakota:* Total length, 880 mm.; tail vertebrae, 265; hind foot (c.u.), 125. *Skull* (type): Greatest length, 127.1; condylobasal length, 122.2; zygomatic breadth, 80.5; interorbital breadth, 25.8; least width of palatal shelf (between last molars and interpterygoid fossa), 15.8; upper toothrow, exclusive of incisors (alveoli), 45.8; upper carnassial, crown length, 8.8, crown width, 9.

*Remarks.*—The raccoon of the upper part of the Mississippi Valley is readily distinguished by much larger size, especially the skulls, from its eastern relative, *P. l. lotor*. It is less easily separated from *P. l. fuscipes*, of Texas, which is of

about the same size, but typical specimens differ in color and cranial details as pointed out. Intergradation is evident, but in the sum of characters presented these widely ranging forms are quite distinct. *P. l. hirtus* is based upon the study and comparison with related subspecies, of over fifty specimens from the distribution area outlined.

### **Procyon lotor varius,** subsp. nov. Alabama Raccoon

*Type.*—From Castleberry, Conecuh County, Alabama, No. 158246, female adult, U. S. National Museum (Biological Survey collection), collected by A. H. Howell, October 10, 1908. Original No. 1359.

*Distribution.*—Western Kentucky, Tennessee, western North Carolina, Mississippi, Alabama, and western Georgia.

*General characters.*—A small subspecies most closely resembling *Procyon lotor lotor*, but smaller, usually paler, pelage much shorter, and skull differing in detail. Differing from *P. l. elucus* in paler color, rather decidedly smaller size, and in cranial features. Similar to *P. l. fuscipes* in color, but much smaller, with a different skull.

*Color.*—*Type:* Upper parts in general light buffy grayish, with a light ochraceous buffy suffusion along median dorsal area, becoming more intense on nape and shoulders, thinly overlaid with black; sides clearer gray, the black-tipped hairs of dorsum thinning out; top of head mixed brownish black and gray; facial mask brownish black, becoming rusty brownish on median line between eyes, and ochraceous buffy on upper surface of muzzle; sides of muzzle, lips, and chin white; underparts in general thinly overlaid with buffy grayish; throat patch brownish black; ears grayish with small black patches at posterior base; limbs grayish, becoming whitish on feet; tail above with five black rings and a black tip, alternating with light ochraceous buffy rings, the dark rings becoming buffy and less distinct below (varying to six rings, more clearly defined below in other specimens).

*Skull.*—Small and slender with weak or obsolescent postorbital processes of frontals; very similar to that of *P. l. lotor*, but smaller and more delicate in structure; jugal narrower; sides of frontals diagonally behind and below postorbital processes usually less deeply indented or laterally constricted; canine—molariform toothrow shorter; posterior upper premolar and upper carnassial usually distinctly smaller; very similar to that of *P. l. elucus* in general form, but rather decidedly smaller; braincase narrower, frontal region flatter, less "humped." Compared with that of *P. l. fuscipes* the skull is much smaller, more slender, with narrower frontal region, and postorbital processes of frontals (not very prominent in *fuscipes*) less developed.

*Measurements.*—*Type:* Total length, 720 mm.; tail vertebrae, 218; hind foot (c.u.), 103. An adult male from Hurricane, Alabama, 772; 258, 109. *Skull* (type): Greatest length, 104.8; condylobasal length, 98.6; zygomatic breadth, 64.4; interorbital breadth, 22.5; least width of palatal shelf (between last molars and interpterygoid fossa), 14.6; upper toothrow, exclusive of incisors (alveoli), 39.8; upper carnassial, crown length, 7.8, crown width, 7.9.

*Remarks.*—The Alabama raccoon agrees more closely in combination of characters with typical *lotor* than with any of the other known subspecies, although its

distribution area constitutes a wedge, separating the ranges of *elucus*, *fuscipes*, and other forms of the southeastern United States. Intergradation with these forms is evident but the lines of demarcation between them appear to be fairly sharply drawn. Thirty-seven specimens from 16 localities in the states mentioned have been examined.

### **Procyon lotor litoreus,** subsp. nov. Saint Simon Island Raccoon

*Type.*—From Saint Simon Island, Glynn County, Georgia. No. 2450, adult (probably male), skull only, U. S. National Museum; collected by L. M. Wilson; entered in museum catalogue, August 7, 1856.

*Distribution.*—Coastal strip and islands of South Carolina and Georgia.

*General characters.*—Size medium and color dark, much as in *Procyon lotor elucus;* length and texture of pelage about the same; skull differing in detail, especially in the much heavier dentition. Similar to *P. l. lotor* in color, but pelage shorter, more bristly, and cranial characters distinctive.

*Color.—Adult topotype (No. 1609):* Upper parts in general buffy grayish, becoming light ochraceous buffy on shoulders and deep rusty rufous on nape patch, heavily overlaid with black; black-tipped hairs most abundant over median dorsal area, thinning out along sides of body; top of head mixed black and gray; facial mask black, becoming brownish on median line; under parts in general overlaid with pale buff; throat patch brownish; ears light buffy, with black patches at posterior base; fore limbs light buffy or soiled whitish; hind limbs about like sides of body, becoming brownish black all around above ankles, and soiled, yellowish white on feet; tail with five brownish black rings and a black tip, alternating with ochraceous buffy rings. A topotype is somewhat grayer, especially on head and along sides.

*Skull.*—Similar in general form to that of *P. l. elucus*, but frontal region narrower and flatter, the sides usually more compressed or abruptly indented behind postorbital processes, leaving the braincase bulging laterally instead of tapering gradually into orbit as in *elucus;* dentition much heavier throughout, the difference being most noticeable in the large molariform teeth. Compared with that of *P. l. lotor* the skull is usually larger, with much heavier dentition; postorbital processes of frontals weak or obsolescent as in *lotor* and *elucus*.

*Measurements.—Adult topotype:* Hind foot (dry skin, c.u.) 107 mm. *Skull* (type): Greatest length, 116.6; condylobasal length, 109.4; zygomatic breadth, 72.9; interorbital breadth, 22.2; least width of palatal shelf (between last molars and interpterygoid fossa) 15.8; upper toothrow, exclusive of incisors (alveoli), 43.6; upper carnassial, crown length, 9.6, crown width, 9.9.

*Remarks.*—The remarkably heavy dentition readily distinguishes the present form from all others of the group inhabiting the eastern United States. Its large teeth are only equalled elsewhere in the group in some of the larger subspecies of the western states and southern Mexico and Central America. The subspecies is based on 13 skulls and two skins from the type locality, and 14 other specimens from the coast and islands of South Carolina and Georgia. Specimens from Saint Simon Island appear to reach the maximum in dental development, but are closely approached by those from Eddings and Saint Helena Islands, South Carolina, and from the adjacent mainland in both states. The Saint Simon Island series was

taken many years ago, and unfortunately the two skins cannot be associated with corresponding skulls.

**Procyon lotor excelsus,** subsp. nov. Snake River Valley Raccoon

*Type.*—From Owyhee River, Oregon, 10 miles west of Fairylawn, Owyhee County, Idaho, No. 236214, old male adult, U. S. National Museum (Biological Survey collection), collected by J. W. Fisk, April 15, 1920.

*Distribution.*—Snake River Valley in southeastern Washington, eastern Oregon, and southern Idaho, and Humboldt River Valley, Nevada.

*General characters.*—Size largest of the group; color rather pale; similar in color to *Procyon lotor psora*, but usually paler, and much larger, with skull differing in detail. Closely allied to *P. l. pacificus*, but much larger, decidedly paler, top of head much grayer, and cranial characters distinctive.

*Color.—Type.* Upper parts of body in general very light buffy grayish, with a light ochraceous buffy suffusion along median dorsal area, becoming pronounced on nape, moderately overlaid with black; sides clearer gray, the overlying black-tipped hairs less numerous than on dorsum; top of head a grizzled mixture of black and gray; face with the usual black mask and white markings; underparts in general thinly overlaid with buffy grayish, the light brownish undertone showing through; throat patch dark brownish; ears grayish with black patches at posterior base; limbs grayish, the hind legs with small, unmixed brownish areas on outer sides near heels; tail above with six black annulations and a black tip, alternating with somewhat broader, light buffy rings, the dark rings becoming indistinct below.

*Skull.*—Similar to that of *P. l. psora*, but larger and more angular; frontal region broader, generally flattened, and postorbital processes well developed, as in *psora*. Compared with that of *P. l. pacificus* the skull is larger, with braincase relatively more elongated; frontal region broad as in *pacificus*.

*Measurements* (no skin measurements available).—*Skull* (type): Greatest length, 136.5 mm.; condylobasal length, 125.8; zygomatic breadth, 89.1; interorbital breadth, 30.1; least width of palatal shelf (between last molars and interpterygoid fossa), 17.2; upper toothrow, exclusive of incisors (alveoli), 47; upper carnassial, crown length, 9, crown width, 10.6.

*Remarks.*—The present form is easily distinguished from all others of the group by the large size and massive development of the skull. No close cranial comparisons with forms east of the Rocky Mountains are necessary as this race differs notably in much larger size, and in the broad, flat frontal region, with prominent postorbital processes (frontal region generally high and narrow, and postorbital processes weak, or obsolescent, in forms east of Rocky Mountains). Twenty-six specimens from localities in Washington, Oregon, Idaho, and Nevada, have been examined.

**Procyon lotor vancouverensis,** subsp. nov. Vancouver Island Raccoon

*Type.*—From Quatsino Sound, Vancouver Island, British Columbia. No. 135457, male adult (skull only), U. S. National Museum (Biological Survey collection); collected by Charles Sheldon, November, 1904; X catalogue No. 5117.

*Distribution.*—Known only from Vancouver Island.

*General characters.*—A dark subspecies most closely allied to *Procyon lotor pacificus*, but decidedly smaller, and cranial details distinctive.

*Color.—An adult (winter pelage) from Beecher Bay, Vancouver Island:* Upperparts in general grayish, heavily overlaid with black; small nape patch suffused with ochraceous buff; top of head mixed black and gray, the black predominating; face with brownish black mask, the dark color extending down along middle of muzzle to nose; sides of muzzle, lips, and chin white; underparts in general thinly overlaid with buff gray, the dense brown under fur showing through; throat patch brownish, mixed with gray along median line; ears grayish, with black patches at posterior base; limbs similar to underparts, becoming soiled whitish on feet, but hind legs with unmixed, dark brownish areas on outer sides above heels; tail with six narrow black rings and a black tip, alternating with broader grayish rings, the black rings interrupted on under side near base.

*Skull.*—Skull rather small, short, low, broad, and flat, with well developed postorbital processes. Very similar in general form to that of *P. l. pacificus*, but much smaller throughout; braincase relatively smaller and less inflated; nasals narrower and more attenuate posteriorly; pterygoids shorter, less diverging posteriorly; canine-molariform toothrows shorter, the individual teeth much smaller.

*Measurements.—An adult from Beecher Bay, Vancouver Island:* Hind foot (dry skin, c.u.), 112 mm. *Skull* (type): Greatest length, 116; condylobasal length, 108.9; zygomatic breadth, 77.5; interorbital breadth, 25.4; least width of palatal shelf (between last molars and interpterygoid fossa), 16.5; upper toothrow, exclusive of incisors (alveoli), 40.2; upper carnassial, crown length, 8.3, crown width, 8.9.

*Remarks.*—The Vancouver Island raccoon is a well marked subspecies, as shown by comparison of a skin and skull and 32 skulls without skins, all from the island, with larger numbers representing various mainland forms. It requires close comparison only with *P. l. pacificus* of the adjacent mainland.

# NOTES ON SYNAPTOMYS COOPERI COOPERI IN WASHTENAW COUNTY, MICHIGAN

By LeRoy C. Stegeman

In the spring of 1929 a large colony of *Synaptomys cooperi cooperi* was found in Washtenaw County, Michigan, five and one half miles northeast of Ann Arbor, near the western village limits of Dixboro. This study was carried on under the auspices of the Museum of Zoology at the University of Michigan and under the direction of Dr. Lee R. Dice.

The area in which the colony occurs is sandy. The fields are covered with a sparse vegetation, consisting of sweet clover, June grass, goldenrod, sorrel, mullein, and other plants. The fence borders are grown up to such shrubs and small trees as wild raspberry, sassafras, aspen, witch hazel, hazel nut, American elm, white and red oak, and sumac. The accompanying map (Figure 1) shows the locations of the fields and wood lots and the size and arrangement of the area. The small circles mark the location of traps in which specimens of *Synaptomys* were taken, and the crosses mark the location of traps in which *Microtus*, *Peromyscus*, *Blarina brevicauda*, or *Pitymys* were taken.

*Synaptomys cooperi*, as has been reported, seems to be colonial and in the territory here studied it was found concentrated in three small areas. In the first of these areas, about 100 feet square, 10 specimens were taken; in the second one, 50 feet wide by 200 feet long, 14 specimens; and in the third, which covered about one acre, 16 specimens. The other captures were distributed over neighboring areas. This would make, for the area in which they were taken, an average of about 14 per acre. *Microtus* has about an equal concentration in part of the area considered.

The runways are like those of *Microtus*, and at irregular intervals they have side chambers which seem to be used as feeding and resting places. Cut grass stems were found in these stations, and green colored feces, though scattered throughout the runways, were here accumulated. The usual arrangement in the system of runways is shown in Figure 2, which is to scale.

The runways are heavily covered with dead grass and it is an easy matter to tell whether or not a runway is being used by the presence or absence in it of fresh feces and freshly cut sections of grass stems. When the runways are being used the grass is kept cut close to the ground, so there is no obstruction in the passage; they become obscured or obliterated very rapidly when they are no longer used. The dead grass

falls down, and the living grass springs up from the bottom of the runways.

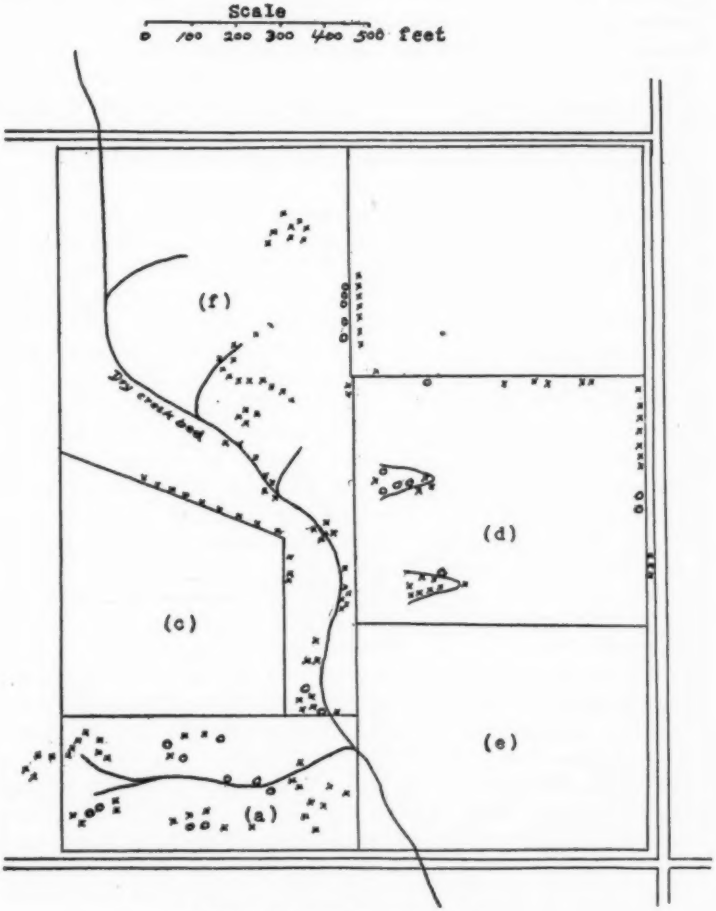


FIG. 1. MAP OF TRAPPING AREA

Many runways were examined in which only *Microtus pennsylvanicus* and *Blarina brevicauda* were caught, and others in which *Synaptomys*

*cooperi* were taken, and no distinguishing features in the runways were found. As a matter of fact, all these species were sometimes taken from the same runway. In the runways used only by *Microtus* the feces seemed somewhat larger but were green in color like those in *Synaptomys* runways. The runways led to many burrows which seemed to be used as retreats, since feces were found in them as well as occasional sections of grass stems. Many of these burrows were followed out. No signs of nesting were present, except in one, and I feel quite sure this was a *Microtus* runway, since only that species had been trapped there.

The runways of *Synaptomys* in the June-grass meadow (a) are numerous and form a very complicated network. Often they average not more than four feet apart. A portion of this system is shown drawn to scale (Figure 1). In the area along the creek bed (b) the runways are less numerous but similar in their arrangement. In the wooded area (c) no runways were found, except along the side of one or two small hickory saplings that had fallen. In the other wooded area (e) no signs of mice were seen; this area was grazed and free from underbrush and weeds. In the open field (d), except in the two ravines shown, runways are scarce, and judging from the trapping results seem to be inhabited only by *Microtus* and *Blarina*. No features could be seen to distinguish these runways from those used by *Synaptomys*. The trapping results indicate about one third as many individuals in this area as in the June-grass meadow or along the stream. The ravines are thickly covered with relatively large, much used runways.

The open field (f) is more hilly and the vegetation is in irregular patches. In parts where sweet clover and grasses are plentiful, runways are present. However, only *Microtus* was taken in this area.

The nests were usually found in a slight depression in the ground, alongside the main runways. Several runways from different directions lead to the nest and usually connect with it through a single entrance. Two nests were found, each with two entrances.

The nests are made entirely of dry grass and resemble the nests of *Microtus pennsylvanicus*. In fact, only one nest was found that I know positively belonged to *Synaptomys*, and that one contained three young about six days old. This nest arrangement is shown in the drawing of runways (Figure 2). Many of the nests had been dug out by skunks which, judging from the signs, are plentiful in the area. The old nests are easily distinguished by their caved-in and moist condition. The new ones are well arched and dry.

It is worthy of notice that the sex ratio in the collection of *Synaptomys*

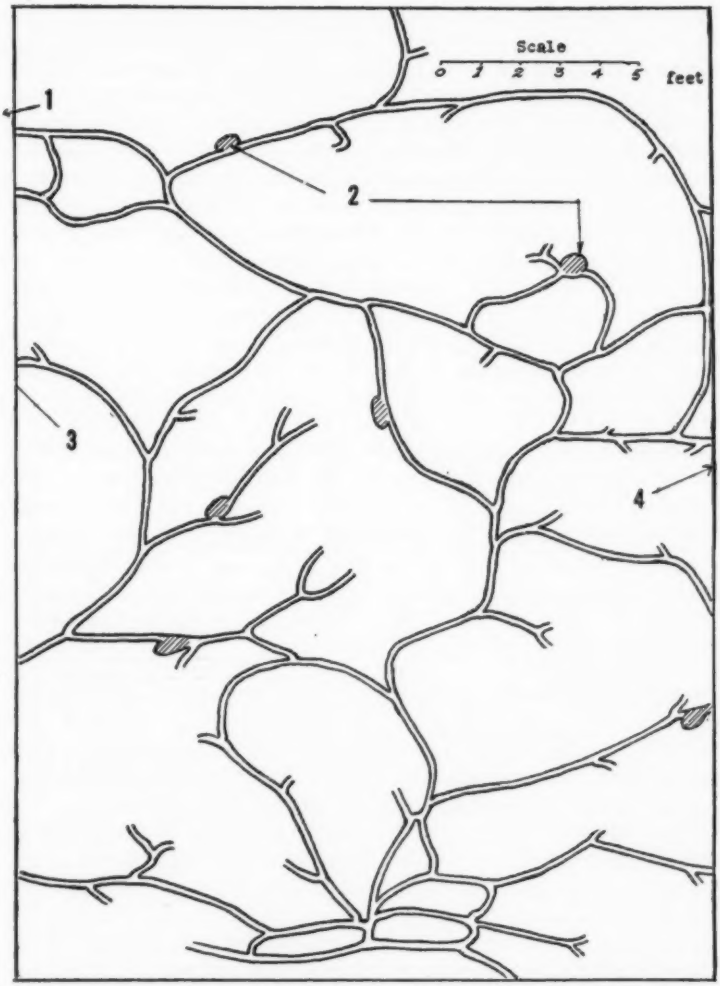


FIG. 2. SURFACE RUNWAYS AROUND BURROW NO. 1, WHICH IS IN THE BANK OF A CREEK

*1*, a distance of 18 feet to nest No. 2; *2*, typical resting stations; *3*, a distance of 10 feet to burrow No. 2; *4*, a distance of 25 feet to nest No. 1.

from Washtenaw County in the Michigan Museum of Zoology is 1 female to 2.75 males, there being eight females and twenty-two males. Because the specimens in the Museum collection are from many different localities in Michigan and may not all be of the same subspecies, only those from Washtenaw County are here considered. In my collection I have 9 females and 33 males, or a ratio of 1 female to 3.66 males.

Specimens of *Synaptomys* in the Museum collection from Washtenaw County, Michigan (adults only) 6 males and 1 female, present the following record of measurements and weights:

| | LENGTH | TAIL | HIND FOOT | EAR | WEIGHT |
|---|---|---|---|---|---|
| | *mm.* | *mm.* | *mm.* | *mm.* | *grams* |
| Maximum | 120 | 20 | 19 | 9.5 | 27.0 |
| Minimum | 110 | 15 | 17 | 6.0 | 20.0 |
| Average | 114 | 17.8 | 17.9 | 7.5 | 24.8 |

Specimens in my collection (33 males and 9 females) from the Dixboro locality have the measurements and weights as follows:

| | LENGTH | TAIL | HIND FOOT | EAR | WEIGHT |
|---|---|---|---|---|---|
| | *mm.* | *mm.* | *mm.* | *mm.* | *grams* |
| Maximum | 126 | 23 | 18.3 | 9.5 | 27.0 |
| Minimum | 108 | 16 | 16.2 | 8.3 | 13.0 |
| Average | 112.5 | 19 | 17.1 | 9.6 | 21.4 |

No significant difference between the sexes was found in the measurements.

From my observations it appears that *Synaptomys cooperi cooperi* is chiefly herbivorous, feeding on grass stems and seeds. Sections of grass stems are found in the runways and the resting places.

The specimens kept in the laboratory were found to eat grass, clover, dandelions, plantain, narrow leaf dock, lettuce, and ground feed consisting of corn meal, wheat middlings, rolled oats, etc. They will also eat insects, at least some coleopterans, although they do not appear to be as fond of such food as is *Peromyscus*. An unsuccessful attempt was made to feed them carrots, carrot tops, radishes, and celery. Apple was eaten by only one individual.

I examined eight stomachs, taken from animals killed in the field, and six of these contained nothing but finely ground, green plant material, apparently grass. The remaining two contained some dark material

which I could not identify, except for a small piece of the wing cover of some coleopteran.

The size of the litter among my specimens varied from two to four: one female had two embryos in each horn of the uterus; one had three embryos in one horn and none in the other; and a third had two embryos in the left and one in the right horn. One litter of three young was found in a nest in the field and one litter of two was born in the laboratory.

A female nursing young was found to be pregnant, which indicates that at least two litters may be born in rapid succession. I have as yet had no success in breeding them in captivity, and therefore, have no information on the period of gestation.

From the above observations the season for the young is from the middle of April to the middle of May. The young found in the field were born about April 6; a litter was born in the laboratory on April 16. The young caught in the field later must have been born about that same time, judging from their stage of development.

Two pairs of mammae are pectoral in position and one pair is inguinal. This agrees with observations by Harper (New York State Museum Handbook No. 8, p. 100, figure 22.)

The following is a record of the growth of the young born in the laboratory.

| DAY | HAIRED OR NAKED | COLOR ABOVE | COLOR BELOW | WEIGHT ♂ ♀ | EYES |
|---|---|---|---|---|---|
| 1 | Naked | Pink | Pink | 2.7; 2.4 | Closed |
| 2 | Naked | Slightly gray | Pink | ..... | Closed |
| 3 | Naked | Dark gray | Pink | ..... | Closed |
| 4 | Naked | Dark gray | Pink | ..... | Closed |
| 5 | Hair apparent | Gray brown | Nearly white | ..... | Closed |
| 6 | Hair present | Light brown | Light gray | ..... | Closed |
| 7 | Hair present | Light brown | Light gray | ..... | Closed |
| 8 | Hair present | Light brown | Light gray | 8.5; 8.0 | Closed |
| 9 | Hair present | Light brown | Light gray | 10.1; 9.1 | Closed |
| 10 | Hair present | Light brown | Light gray | 11.2; 10.2 | Closed |
| 11 | Hair present | Light brown | Light gray | 12.2; 11.2 | Closed |
| 12 | Hair present | Light brown | Light gray | 11.6; 10.9 | Open |

One litter estimated to be about six days old, two males and one female, found in a nest in the field, was placed with a laboratory house mouse as a foster mother, but without success. The house mouse seemed to adopt them readily, but the young *Synaptomys* would not

nurse. An attempt to feed the last survivor on cow's milk, with a medicine dropper, was also unsuccessful.

From the sixth day the mammae become very evident and the females can then easily be distinguished by the greater development of this character, until the hair on the ventral surface becomes long.

External parasites were very numerous on the specimens taken early in the spring, but later specimens were much less heavily infested. Mites, fleas, and lice were all present, but these have not yet been identified as to species.

*New York State College of Forestry, Syracuse, New York.*

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## DETERMINING THE RATE OF REPLACEMENT IN A SPECIES

By Theo. H. Scheffer

Our discussion of the determination of the rate of replacement in a species will be confined to the natural groups of the smaller burrowing mammals that have come directly under our observation in a period of many years' study. From no data available to the writer does it appear that the fundamental factor of gestation period will undergo any change to effect more speedy multiplication of the species. Readers of the Journal will perhaps be more interested in material we have gleaned in the field than in abstract discussion of the rates of replacement in general.

From a survey of this biological problem in the Pacific northwest, we find that the mole (*Scapanus*), the mountain beaver (*Aplodontia*), and the smaller ground squirrels (*Citelus*), furnish good examples of species having a very definite breeding season. This period is brief, occurs in the early spring, and allows for the production of but one litter. In each species, therefore, the main factor entering into the rate of annual replacement is the average number of young at a birth. For the moles this number is small, being approximately but three in the case of the Townsend mole (*Scapanus*), and four with the eastern mole (*Scalopus*). It is the opinion of the writer that this low rate of replacement is correlated with the animal's secluded life habits and its distasteful qualities as an object of food. The mountain beaver is in a class somewhat comparable to that of the mole with respect to natural protection, and commonly produces only twins or triplets in its brief breeding

season. The ground squirrels, on the other hand, are involved in the struggle for existence above ground in the daylight hours, and must recoup their consequent heavier losses by a higher rate of replacement. Their number of young, one brood to the season, is more commonly eight to ten, with a maximum, in my observations, of sixteen.

The brief mating period in these groups of small mammals is preceded by a fairly rapid seasonal development of the sexual organs,

TABLE 1

*Summary of a season's breeding records for Perognathus lordi, at Lind, Washington*

| COLLECTING DATES | SPECIMENS TAKEN | | | | PREGNANCY | | | | NUMBER OF FETUSES | PERCENTAGE PREGNANT |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Males | Females | Immature | Early | Medium | Advanced | Total cases | | |
| January 9–11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ..... | .. |
| February 25–March 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ..... | .. |
| April 2–9 | 80 | 76 | 4 | 0 | 0 | 0 | 0 | 0 | ..... | .. |
| May 7–12 | 133 | 75 | 58 | 0 | 3 | 0 | 0 | 3 | 4, 4, 5 | 5 |
| May 28–June 2 | 116 | 65 | 51 | 0 | 2 | 7 | 0 | 9 | 4, 4, 4, 4, 4, 4, 3, 2, 3 | 18 |
| June 25–30 | 146 | 77 | 67 | 2 | 11 | 11 | 3 | 25 | 4, 7, 5, 7, 4, 4, 6, 5, 5, 5, 4, 5, 5, 4, 5, 5, 4, 6, 4, 5, 6, 4, 8, 4, 4 | 37 |
| July 23–30 | 194 | 85 | 81 | 28 | 15 | 13 | 4 | 32 | 7, 5, 5, 6, 6, 8, 8, 7, 6, 6, 5, 5, 5, 5, 4, 4, 5, 5, 5, 5, 6, 5, 6, 6, 5, 8, 5, 5, 5, 6, 7, 5 | 40 |
| August 28–30 | 224 | 35 | 61 | 128 | 5 | 3 | 0 | 8 | 5, 4, 5, 4, 4, 4, 5, 6 | 13 |
| September 23–28 | 130 | 27 | 29 | 74 | 0 | 0 | 0 | 0 | ..... | .. |
| November 2–10 | 40 | 30 | 10 | 0 | 0 | 0 | 0 | 0 | ..... | .. |
| December 10–14 | 5 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | ..... | .. |

especially in the cases of the two rodents. After the mating, the males make quick recession to out of season condition, and the females develop and rear their young.

We have not infrequently noted failures to mate among females of burrowing animals whose lives of comparative seclusion and isolation materially reduce the chances for the meeting of the sexes, while no such condition was observed among the more social sun-loving ground squirrels.

In contrast to the three groups of smaller burrowing mammals whose breeding habits we have briefly considered, we may present three others

in which the female is able to rear two or more broods a year. In the pocket gophers (*Thomomys*) and the pocket mice (*Perognathus*) of the Pacific northwest, the breeding period as observed in several seasons' investigations is usually about ten to twelve weeks for the former and two or three weeks longer for the latter. The species of *Peromyscus* (*P. maniculatus gambelii*) found in east central Washington breeds throughout the year, at least in the grain growing section (Journ. Mammalogy, vol. 5, no. 4, pp. 258–260, 1924).

The pocket gopher, *Thomomys douglasi yelmensis*, on the Olympia prairies of western Washington, breeds from late March to early June, as indicated by pregnancy records in three seasons' investigations. Less complete records for *T. bulbivorus*, in the Willamette Valley, Oregon, indicate a period of practically the same extent. Pregnancy records are bunched so closely that it is only the exceptions that would indicate the rearing of more than one brood by the same female. On this point the writer has no direct evidence. The number of young at a birth is practically the same in the two species, close to five.

In the semi-arid grain growing section of central Washington the pocket mouse (*Perognathus lordi*) breeds in midsummer, June, July, and August, with a few pregnancy records in the latter part of May. Within this period there is opportunity for the rearing of second broods by some individuals, and evidence pointing to that condition is presented in table 1. It will be noted that not less than fifty females were trapped at each of the periodical pregnancy counts, with an average number of sixty-three for the five dates on which the field census was taken.

The question at issue is the validity of this or similar data in determining the number-of-broods factor by which to multiply the average-litter factor in an attempt to arrive at the annual replacement rate, irrespective of gain or loss in the species. The writer believes that when the period of gestation is fairly definitely known, by trapping a large number of specimens at regular intervals approximating this period, throughout the breeding season, percentages of pregnancy in the field at large may be obtained and these added to obtain the number-of-broods factor. In the case of *Perognathus lordi* this is 1.13. We do not mean to assume, however, that 13 per cent of the females in this case breed a second time; for some individuals for one reason or another may fail to support the reproductive program of the race.

The average litter in *Perognathus lordi*, as determined by four seasons' investigations in this same locality, is 5.16. This factor multiplied by the number-of-broods factor gives 5.83 as an approximate annual rate of replacement in the species.

In connection with the pocket mouse studies in eastern Washington we trapped considerable numbers of the local species of white-footed mouse, *Peromyscus maniculatus gambelii*. These were found to be breeding in every month of the year, as noted in four seasons, with an average litter of 5.3, approximately. Not having anticipated a rate-of-replacement investigation of the species, we did not trap at regular intervals corresponding to the gestation period, and perhaps did not obtain at one or two of the trappings enough specimens to fairly represent average field conditions. But the data secured are none the less interesting as applied to the problem under discussion. The number-of-broods factor in this species under the given conditions, as determined by pregnancy in the field at eleven different periods throughout the year, was 4.08. Obviously this factor would have been increased had we secured records at the intervals more nearly corresponding to the animal's gestation period, perhaps thirteen or fourteen such to the year. As the matter stands, however, we get an annual replacement rate of 21.62, more than four times that of the pocket mouse in the same locality. To partially offset adverse factors in the annual increase of the species, we may note here a favorable factor not found in the other five species we have discussed, namely, reproduction within the year by broods produced in that year; for the period required to reach maturity in *Peromyscus* is certainly less than a year.

To conclude, we assume that it would be well worth while to determine the rate of replacement in certain rodents as accurately as possible, particularly where the animals concerned are of prime economic importance. This factor known, it will be easier to arrive at the comparative annual increase in a species by combining it with other factors, favorable and adverse. We hope to follow up this study with the pocket gophers, whose reproductive behavior in different regions, and as affected by agricultural operations in the habitat, has been most puzzling.

*U. S. Biological Survey, Puyallup, Washington.*

# THE WATER OPOSSUM—CHIRONECTES PANAMENSIS GOLDMAN

By James Zetek

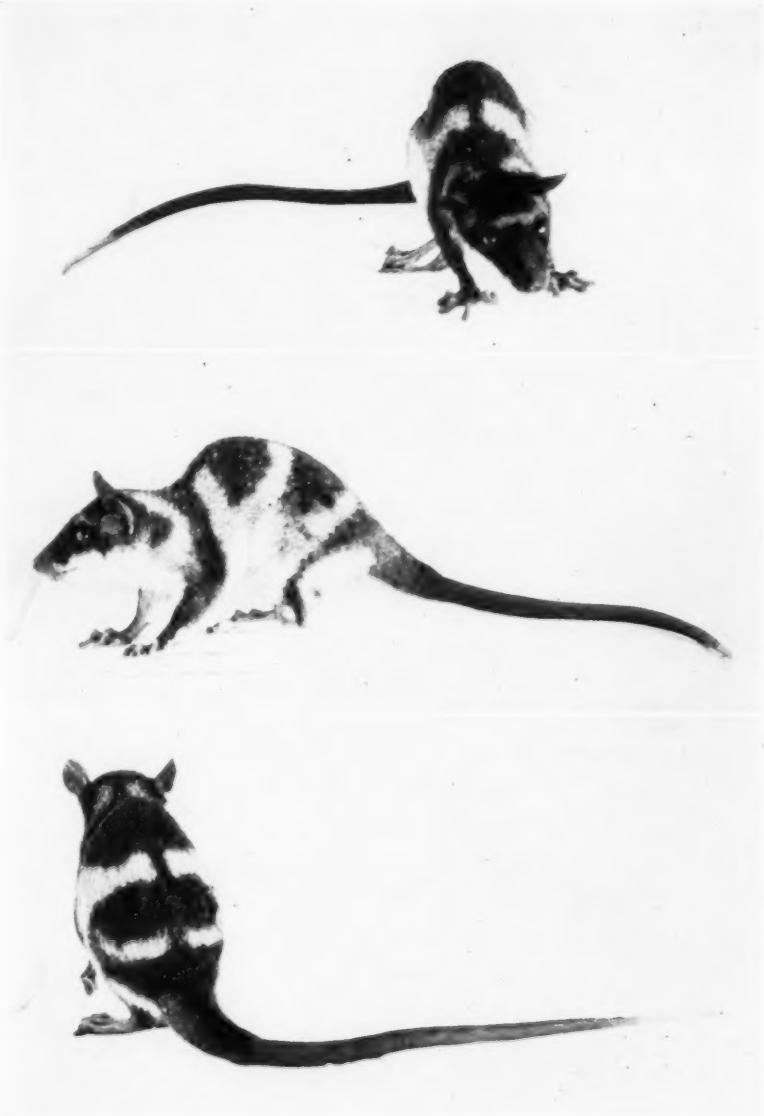
[*Plate 20*]

In the early part of April, 1930, Mr. James B. Shropshire, Sanitary Inspector in charge for the U. S. Army in the Panama Canal Zone, was very fortunate in capturing an adult male of this rare and interesting marsupial, and the the writer had the opportunity to study it alive and to obtain good photographs which are here presented. The opossum was caught near Fort Sherman, on the Atlantic side of the Canal Zone, in the same general region where William Beebe spent the greater part of a nasty night about the middle of March in an unsuccessful search for this species, on the eve of his departure for the Galapagos Islands. He devotes the entire second chapter of his "Galapagos-World's End" to this adventure.

The only common name for this animal obtainable was "gato de agua," a name used for nearly every mammal that frequents streams. Beebe calls it "Yapock." The stream at Fort Sherman has running water and innumerable pools in its bed, of various depths. The bank was about four feet high. Shropshire's specimen was found about mid forenoon asleep on the ground above the bank and close to it. It had a very definite nest measuring about six inches in diameter made of leaves of various sorts.

As soon as the animal was disturbed it jumped into the water and dove, coming up shortly on the opposite bank and entering a hole about four inches in diameter, just above the level of the water in the stream. Upon exploration, it was found that the cavity was about two feet deep, somewhat enlarged at the end, and its direction downward at an angle of about forty-five degrees. It contained remnants of crustaceans and the part below the stream level was filled with water.

In the laboratory the opossum slept during the daytime, covering itself with whatever was placed in the cage. During the night it was very active. It ate shrimps freely, though dead ones only were placed in its cage. Attempts to photograph it during the first few days met with failure. It would never remain very quiet, trying to escape, and invariably kept opening and snapping its jaws. It would also hump up as if to jump, and when in this attitude the tail appeared to be very much longer than it really was.



WATER OPOSSUM CAUGHT NEAR FORT SHERMAN, CANAL ZONE

After the fourth day it would allow itself to be handled and was much more quiet when photographed. Even so, it was not possible to use the camera shutter because the animal would move the instant the shutter clicked. A lens cap instead had to be used.

The specimen measured 20.5 inches from tip of nose to tip of tail; the tail was 12 incles long, of which the extreme two inches were almost pure white in color. The underparts, inner faces of the thighs, and the upper parts of the hind feet are white. The illustrations show the distinctive color pattern.

*Ancon, Canal Zone.*

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## THE SPRING MOULT OF MUSTELA LONGICAUDA

By Frederic W. Miller

The seasonal changes of color in the pelage of the northern weasels from the white of winter to the brown of summer, and back again, have been the subject of no little description. Nevertheless, detailed accounts of individual changes of pelage are few, and much of the literature relating to the subject is drawn from the remarks of Audubon and Bachman (1849) dealing with the New York weasel. Their observations on a captive specimen demonstrated satisfactorily that these seasonal variations in color result from a semi-annual moult and not, as was sometimes believed at that period, from the changing of the pigment in the hair itself.

On February 26, 1930, I received a live specimen of *Mustela longicauda longicauda* Bonaparte, from western Adams County, Colorado. The animal had one front foot slightly injured in a trap, but it soon recovered from this injury and was otherwise in perfect condition. When received, it was in the full white coat of winter, with only the black tail pencil and supra-orbital spots contrasting with the immaculateness of its pelage.

The animal was established in an indoor cage and after the beginning of the moult close observations were made on the process of change to the brown of the normal summer pelage.

On March 10 the first indication of the moult was detected in a shadowy sprinkling of dark brownish hairs on the back of the head immediately behind the right ear. Other new dark hairs appeared rapidly;

two definite post-auricular spots were clearly defined by the 15th, the one on the right being slightly the larger. On the 18th another concentration of dark hairs could be seen on the back between the shoulders and there were four dark spots dorsally on the mid-line of the pelvic and posterior lumbar regions.

These three independant areas of origin are illustrated in Fig. 1, A. Daily the three areas increased in dimension and density of new hair, so

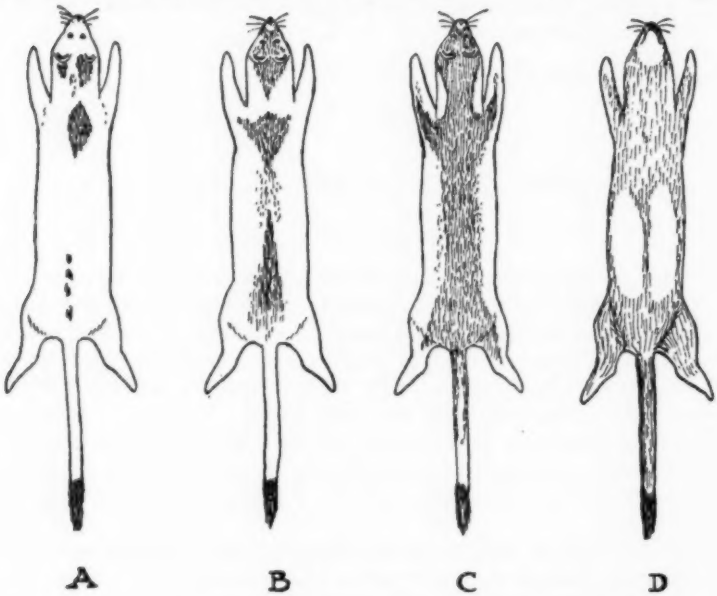


FIG. 1. A, B, C, D. PROGRESS OF SPRING MOULT IN MUSTELA LONGICAUDA

that by the 24th the auricular spots had joined and were progressing rapidly backward along the neck in an attenuated line. They extended forward with less rapidity. At the bases of the whiskers on the muzzle a few dark hairs appeared also on this date. The separated spots on the rump had joined in a thin dark line and additional outlying spots appeared. The dark area between the shoulders had increased in all four directions but most particularly posteriorly. On the 26th scattered hairs of the new coat darkened the head, face, and sides of the muzzle.

The shoulder and rump areas were merging so that on the 27th the animal's dorsal aspect presented the pattern shown in Fig. 1, B.

The white of the old winter coat by this time had become worn and had lost much of its pristine brightness. In the nest material supplied the weasel there were accumulations of shed white hairs. By the 29th the entire dorsal area had been moulted in a line extending from head to rump; laterally the base of the tail was showing lines of new hair. Fig. 1, C. represents this stage.

The moult gradually spread laterally and the new hair increased in density as the isolated white hairs which had been enclosed with the pattern were shed out. On April 1 the moult was extending downward along the legs; on the ventral surface of the neck there were many scattered hairs of sulphur yellow. On April 6 the brown part of the summer coat was complete as to area, even on the flanks, and on the legs quite to the feet. Along its edges came a line of new sulphur-yellow hair, of the same color as that destined to replace the old white of the underparts. On the inner surfaces of the legs, also, there were concentrations of these new hairs. The tail was completely brown with the exception of superior and inferior lines of unshed white hairs; the long black hairs of the pencil were being rapidly replaced by the shorter black ones of the summer coat. Only two areas of the old white remained on the belly. These areas were about an inch and a half long and were separated by a line of new yellow hairs, as indicated in Fig. 1, D. The two areas decreased in size very gradually, and were not obliterated until May 25 when the weasel was assumed to have completely attained the summer pelage, though a scattering of winter hair still remained to be shed.

The moult, then, had taken practically 57 days, or nearly two months. What effect captivity and the increased and fairly constant temperatures of its new environment had, must of course remain unknown. However, they can not reasonably be supposed to have retarded it, but, on the other hand, they might have caused some acceleration. The spring moult in *Mustela longicauda*, in this case at least, shows no definite correlation with temperature, a factor which Coues (1877) regarded as of considerable importance in regulating the time and speed of the transition.

I wish to thank Dr. E. Raymond Hall for welcome criticism and advice during the course of this study.

# A PAIR OF DEFORMED ROCKY MOUNTAIN GOAT HORNS

By William L. Jellison

[*Plate 21*]

Normally both sexes of the Rocky Mountain Goat, *Oreamnos americanus*, bear a pair of simple horns attached to the frontal bones. An old male with a second pair of short, stumpy, erect horns or horn-like structures placed immediately behind the normal horns is here reported.

The goat was killed in Mill Creek Canyon, Ravalli County, Montana, February 12, 1930, by C. B. Philip, under state permit granted to the U. S. Public Health Service at Hamilton in connection with its Rocky Mountain spotted fever investigations. A young male was killed at the same time bearing a normal well shaped head.

The right secondary horn, which became detached in cleaning the skull, was partially hollow, very irregular in shape and was supported by a firm cartilaginous base on the smooth anterior surface of the parietal bone. Only the base was in contact with the back of normal horn. It measured 42 mm. in height and 102 mm. in basal circumference. The left horny protuberance was similar to the right in texture and position, except that it was more regular in shape and was rigidly attached to the back of normal horn for the entire length. It had a height of 32 mm. and a basal circumference of approximately 106 mm. Neither of the secondary horns was pointed but both had irregular broad-surfaced tops.

The other horns were nearly normal but more slender and of greater spread than those on a well shaped head of a male of comparable size collected at the same time.

That the specimen was an old individual was evidenced by the lack of incisors and the broken and decayed condition of the premolars and molars. The specimen is preserved in the author's collection.

*Hamilton, Montana.*

DEFORMED HORNS OF ROCKY MOUNTAIN GOAT

# A STUDY OF SCENT GLANDS IN THE MARMOSETS, ESPECIALLY OEDIPOMIDAS GEOFFROYI[1]

By George B. Wislocki

[*Plates 22–24*]

Special glandular complexes subserving by their scents the identification of one member of a species by another or, when more or less sex-limited, by playing a rôle in the sphere of sex-attraction, exist in amazing variety of location and form in the skin of mammals. They are thought to be most highly developed in those animals which are macrosmatic; vestigial or absent in those animals in which the olfactory apparatus has become markedly reduced. Support for this contention may be adduced from aquatic mammals such as the cetaceans in which olfaction has undergone complete reduction and which possess no such glands. In the Simiae, also, in which olfaction has been widely overshadowed by other senses, through the growth of the neopallium, scent glands are believed to be minimal in their occurrence. In man and the higher apes none is described unless the localized apocrine glands around the nipples and in the axillary, pubic and anal regions, as well as the sebaceous preputial glands, prove to be of that nature. Evidence has accumulated in recent years (Shiefferdecker '22, Löschke '25, Homma '26) to set aside the axillary glands, at least, as organs which begin to function at puberty and in the female act cyclically until the menopause in correlation with menstruation and gestation. On the other hand, macroscopically differentiated glandular complexes are rare in Simiae. In the orang-utan, Wislocki and Schultz ('25) have described a minute sternal gland. In the spider-monkeys these same observers described two small glandular hillocks upon the chest. In the marmosets Pocock ('20) remarks in several places upon the presence of visible glandular tissue about the genitalia, and Weber ('28) also mentions briefly the presence of scent glands in the Hapalidae. No careful gross or microscopic study, however, of this presumably glandular tissue in the marmosets appears to have been made. Indeed no mention of marmosets is made by Brinkmann ('11, '23) in his extensive studies of glands of the integument

[1] The material for this study was obtained in the Republic of Panama while the writer was working at the Barro Colorado Island Laboratory for Tropical Research. My thanks are due to Mr. J. B. Shropshire and to Dr. James Zetek, custodian of the laboratory, for the opportunity to secure the material.

in mammals, and furthermore Wood Jones ('29) in his recent book on primates says that in the Hapalidae no definite scent glands have been described. He adds, however, that the skin around the external genitalia is modified in both sexes. The writer had an opportunity while at Barro Colorado Island to secure a number of Marmosets, *Oedipomidas geoffroyi*, from the Republic of Panama. The unusual structure of the genital region in this species of marmoset led to a study of it, with subsequent examination of several other species. The results of this investigation appear sufficiently interesting from the standpoint of our knowledge of the relations of the different groups of the Simiae, and because of the histological character of the glands, to report them.

## MATERIAL

The material in hand consists of thirteen specimens of *Oedipomidas geoffroyi*, nine males and four females, collected in the Republic of Panama. Besides this the series contains one specimen of *Seniocebus bicolor*, two of *Callithrix penicillata* and two of *Callithrix jacchus*, South American forms obtained by Dr. Schultz from various zoological parks. These species, together with a few brief notes by Pocock ('20) on the species *Leontocebus rosalia*, *Callithrix jacchus*, *Oedipomidas oedipus* and *Mystax ursulus*, give us some knowledge of the nature of sexual glands in the family Hapalidae (Callitrichidae) as a whole.

The present material was studied microscopically. The material, fixed in ten per cent formalin, was stained with haematoxylin and eosin and with Mallory's connective tissue stain.

My own specimens are recorded according to the nomenclature of Elliot ('13).

## OBSERVATIONS

**Oedipomidas geoffroyi.**—This species has by far the most conspicuous sexual glands of all the marmosets examined. The glands form in the female an extensive organ occupying the circumanal region, the perinaeum, labia majora[2] and the skin of the pubic region. The skin of the lower portion of the abdomen and

[2] The swelling or folds about the vulva termed labia majora can be plainly seen in the figure. I agree with Klaatsch ('92) and Bolk ('07) in homologizing these and similar folds about the vulva, seen in various platyrrhine monkeys, with the labia majora of man. The comparative anatomical evidence adduced by these writers for considering labia majora as being present in the platyrrhines is more convincing than the evidence in support of the opposite view that labia majora are lacking.

of the thighs is unpigmented and covered by fairly sparse, long, wavy hairs, whitish to light brown in color. In this field the glandular organ is pronounced because it is delimited by deeply pigmented skin. The labia majora are black and from them an area of only slightly less pigmented skin extends forward over the symphysis onto the lower portion of the abdomen (Pl. 22, figs. 1 and 2). This glandular extension from the region of the labia is approximately three centimeters long and two centimeters wide at its broadest place overlying the symphysis. The glandular area, besides being demarcated by its color, is brought into bold relief from the surrounding skin by the fact that it is elevated into two cushions which run upwards from the labia onto the lower abdomen, being separated from one another by a shallow furrow or sulcus in the midline (Pl. 22, figs. 1 and 2). Posteriorly the glandular area dwindles as a narrow raphe of pigmented, glandular skin formed by the converging lips of the labia and extending to the anus which is surrounded by slightly pigmented dermis containing small glands.

The glandular region is not entirely hairless, for on careful examination with the naked eye, or on examination with a magnifying lens, it is seen to be covered with fine, sparse hairs which are brownish or blackish in color. Moreover, on close examination, either with the naked eye or with the aid of a lens, the labia majora and the two cushions of glandular tissue are seen to be studded with small crater-like orifices the openings of which appear as minute white dots. From the centers of many of these apertures a minute hair protrudes. However, some of the larger apertures are hairless. The largest of the gland-orifices occur along the main axis of each cushion to the right and left of the median sulcus, as well as upon the bulging surfaces of the labia.

In the four adult female specimens of the series the extent and character of the glandular organ is as described, except for minor differences, which express themselves in the degree of pigmentation and extension upwards of the pubic portion of the gland. In the absence of juvenile specimens, or specimens dated according to the oestrous cycle or pregnancy, it can only be surmised that the gland varies in size with the physiological age and condition of the individual.

In the male, the glandular area is present, but much less extensive and well-developed. The scrotum corresponding to the labia is densely pigmented. The perineal and circumanal regions are much less pigmented than in the female. The pubic region is also pigmented but to a much less degree than in the female. Two low ridges are present extending forward from the scrotal sac over the symphysis to the lower abdomen, but these are much less pronounced than in the female. On gross examination of the male for glandular tissue, it is found that the pubic ridges, corresponding to the glandular organ described in the female, are composed in this instance, too, of glands similar to those found in the female except that they are much smaller in size. In complete contrast to the female, neither the scrotal area nor the perinaeum contains macroscopic glands. Moreover, the scrotal area is hairless.

In specimens of three juvenile males almost no trace of the pubic glands can be seen—a phenomenon which suggests that the glandular complexes develop at the time of puberty.

Microscopically the glandular organ is of considerable interest. In the female it is found developed to its fullest extent. It consists in the pubic region and on the labia majora of a bed of glands fully two to three millimeters in depth (Pl.

23, figs. 5 and 6). The entire gland is composed of a series of small glandular units each developed around a single hair follicle, the hair of which, although attenuated, is present in all except the largest units (Pl. 22, fig. 3 and Pl. 23, fig. 7). The hair follicle of each unit has undergone extensive glandular differentiation producing a series of sebaceous or holocrine acini in close proximity to the surface of the skin and clustering around the remains of the hair shaft (Pl. 22, figs. 3 and Pl. 23, fig. 7). In addition, the follicle has produced an extensive merocrine or tubular gland, the body of which lies beneath the cluster of sebaceous acini and communicates by one or several long tubular ducts with the common atrium of the unit near its crater-like orifice on the skin (Pl. 22, fig. 3, Pl. 24, figs. 9 and 10). Thus we are dealing with a complex gland of both holocrine and merocrine character derived from a highly transmuted and differentiated hair follicle.

The merocrine portion of the unit is of particular interest because of its size and complexity. The fundic portion of thermerocrine gland is spacious and branched. The character of the gland varies considerably in different portions of the same glandular unit, as well as in units from different regions. (Pl. 24, fig. 9 and 10). These differences express themselves in a variability in the amount of distension of the glands and a pronounced difference in the height of the epithelium. The lumen of the gland is invariably filled with products of secretion consisting in part of amorphous or flocculent precipitate, in part of formed bodies which appear as round or slightly irregular disks of variable size, which contain minute granules or a reticulated substance. These formed products in the secretion can be traced to the activity of the epithelial cells lining the glands (Pl. 24, fig. 11).

The epithelial lining is composed of cells of extremely variable height in different portions of the gland. The epithelium is never lower than cuboidal, but in the majority of places it is higher, taking at times the form of exceedingly long and slender columnar cells (Pl. 24, figs. 11 and 12). The distal margins of the epithelial cells, whether cuboidal or columnar, are characteristic. The ends exhibit nodular, club-shaped processes projecting towards the lumen of the gland. These bodies are in process of budding off from the cell-cytoplasm to produce the formed elements or plaques seen in the secretion within the lumen of the gland (Pl. 24, fig. 11). The constant extrusion of the distal portions of the cell cytoplasm in this manner clearly identifies these glands as of the apocrine type. This type of merocrine gland is recognized as being associated with hair follicles and specialized large gland complexes. Apocrine glands are described characteristically, for example, in the axilla and genital regions of the anthropoids and man.

The epithelium of the present glandular structures, however, shows a peculiarity in that it is, in places, pseudostratified, smaller intercalated cells which do not reach the surface lying between the bases of the columnar cells. This finding suggests that some of the columnar cells are occasionally cast off, being replaced by the intercalated or basal cells.

Another characteristic of these glands is the presence at the bases of the secreting cells, of a layer of well developed smooth muscle cells. The latter form a conspicuous layer or sheath of muscle elements lying between the membrana propria and the bases of the epithelial cells. Such an occurrence of so-called myoepithelial cells has been described in other cutaneous glands.

The glands drain by straight narrow ducts into the common atrium of the unit

near the surface. The gland tapers abruptly into the neck-piece, the epithelium undergoing a sharp transition from columnar to low cuboidal epithelium which lines the duct (Pl. 22, fig. 3 and Pl. 24, fig. 4).

The glandular units, as has been said, are different in the degree to which they are distended with secretion. Moreover, the units are largest on the two conspicuous ridges of the pubic area and on the labia. Towards the peripheral limits of the glandular areas they diminish gradually in size. Furthermore, along the median furrow the glandular units are somewhat smaller. On the perineal raphe, as well as around the anus, the glands are also smaller than on either the labia or the pubic skin.

In the male one finds the same type of composite gland throughout the glandular pubic area, although by contrast with the female the glands are small. The sebaceous or holocrine portion of the gland is reduced and apparently functionally almost inactive, while the apocrine portion is relatively more active, in that there are apparent numerous moderately distended glands, lined by cuboidal epithelial cells which show evidence along their distal borders of active secretion (Pl. 23, fig. 8). In the scrotal area glandular differentiation is wanting, neither glands nor hairs being present, whereas in the perineal and anal regions small sebaceous and tubular glands are encountered which do not, however, warrant elevation to the rank of a glandular organ.

**Callithrix penicillata.**—Of this species of marmoset the writer has had the opportunity of examining two specimens. In the adult female specimen the labia majora are pink, unpigmented, puckered and glandular. The puckered glandular structure of the integument extends backwards in this species by a broad raphe to an annular elevation of the anal skin composed of circumanal glands. Anterior to the labia on the pubic region there is no special development of glandular tissue as described in *Oedipomidas*. The glandular area of the labia and of the perinaeum is covered by scarcely visible whitish or grayish hairs which are associated with small orifices which are on the border of visibility to the naked eye. Microscopic sections through the labia majora of this species reveal the presence of small hair follicles associated with moderately enlarged tubular and sebaceous glands.

In the male of this species the extent and location of the presumably glandular area bear close analogy to that in the female. The skin of the genital area is unpigmented. The skin of the scrotum, of the broad perineal raphe, and of the anal circumvallation is puckered. The entire area is covered by sparse, delicate, grayish hairs. On microscopic examination of the scrotum, scattered, slightly enlarged glands both sebaceous and tubular are seen, but in the perinaeum they are neither noteworthy as to size or number.

**Callithrix jacchus.**—In the adult female of this species the presumably glandular area is almost identical with that of *Callithrix penicillata*. The genital area is unpigmented. The glandular area includes the labia majora, a narrow, short raphe extending backwards to the anus and an anal circumvallation. The area occupied by glands has a puckered surface and on close inspection exhibits fine whitish hairs and gland orifices. On microscopic examination of the labia majora of this specimen scattered hair follicles associated with moderately enlarged glands of both the holocrine and apocrine type are encountered.

A male specimen examined is practically identical in the topography of the genital gland with *Callithrix penicillata*. The skin is unpigmented. The glandu-

lar area comprises the scrotum, a slender raphe and the raised circumanal region, and exhibits puckering of the skin, fine whitish hairs and minute glandular orifices.

Of a female specimen of *Callithrix jacchus* Pocock ('20) remarks briefly that there are numbers of whitish pustules around the anus, on the perinaeum and on the ischial prominences. These exude under pressure a sebaceous substance which may be odoriferous. Concerning a male specimen he says that in the marmoset, *Callithrix jacchus*, the naked circumanal integument, the ischial prominences, the scrotum and the area above the scrotum are studded with white glandular pustules like those of the female. According to the present investigation these observations are inaccurate in that the areas under consideration are not hairless. Moreover, the glands in question are derivatives of hair follicles in which the original hairs, although small, are present in all except the largest glandular units. Further, in the present specimens the glandular structure cannot be said to be located on the ischial prominences nor in the male above the scrotum. Finally, the term "pustule" in describing the surface elevation of the glandular units denotes a pathological lesion for which there is no evidence in the present observations; the apparent existence of the yellowish-white secretion is to be attributed to the intraglandular accumulation of secretory products rather than of pus.

**Seniocebus bicolor**.—In an adult male specimen in the present series no special glands are visible. The scrotal area exhibits black pigmentation and is covered by delicate blackish hairs.

In addition to the above species of marmosets we have the following brief observations of Pocock upon other members of the family.

**Leontocebus rosalia**.—In a male and in a female specimen there are no traces of pustules.

**Oedipomidas oedipus**.—In a female specimen there are no traces of glands.

**Mystax ursulus**.—In a male the subcaudal integument is without glandular pustules.

## CONCLUSION AND SUMMARY

Complex scent glands, located in the pubic region, on the genitalia, or in the perinaeum, are characteristic of a number of the Callitrichidae. They are most extensive in *Oedipomidas geoffroyi* amongst the species examined. They are also well-developed in *Callithrix penicillata* and *Callithrix jacchus*. In *Seniocebus bicolor* (male), as well as, according to Pocock, in *Leontocebus rosalia* (male and female) and in *Oedipomidas oedipus* (female) there are no special glandular complexes. Their absence in the latter species cannot be fully affirmed, however, until authenticated adults, both male and female, have been examined microscopically.

The glands are not sex-limited, either in *Oedipomidas geoffroyi*, nor in the two species of *Callithrix* examined. However, in *Oedipomidas geoffroyi*, they are much more extensively developed in the female than

in the male. Microscopic examination reveals that the glands are developed from highly modified hair follicles in which the tubular and sebaceous components have produced complex holocrine and apocrine glands which are functionally extremely active.

Complex glands of the skin are a rarity in the Simiae. In comparison with the glands found in Callitrichidae (Hapalidae) nothing of similar complexity is known. There exist observations by Schultz and Wislocki on minute sternal glands in spider-monkeys and in the orang-utan, as well as a number of reports on specialized apocrine glands visible microscopically in the axilla and genital regions of man and the anthropoid apes. The finding of complex genital glands in marmosets is in keeping with the belief that the organization of these animals is primitive and that they represent the lowest order of the Simiae. Of all the Simiae, the Callitrichidae show the greatest development of the rhinencephalon and the least development of the neopallium, a condition which is in all likelihood correlated with the presence of extensive glands in the integument.

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## EXPLANATION OF PLATE 22

FIG. 1. Photograph of the lower abdominal region of an adult female marmoset (*Oedipomidas geoffroyi*), showing the external genitalia. Posteriorly the rounded labia majora can be seen, anteriorly over the pubic region two rounded masses of glands are noted separated in the midline by a shallow furrow. Anterior to the main masses two subsidiary masses extend onto the lower abdomen. The labia majora as well as the glandular area, are deeply pigmented in contrast to the unpigmented skin of the abdomen and thighs. × 1.

FIG. 2. Photograph of the lower abdominal region of another adult female marmoset showing a slightly different appearance than in the preceding specimen. Anterior to the labia two flattened, pigmented glandular ridges can be seen extending upwards over the pubic region onto the lower abdomen. × 1.

FIG. 3. Photograph of a section showing a portion of the complex gland from the labia majora. Note the extensive development of holocrine glands in the neighborhood of the hair follicle. Several narrow ducts, (indicated by the use of leaders and an asterisk), the outlets of the apocrine component of the gland, can be seen coming up from the deeper portion of the gland. × 52.

FIG. 4. Photograph of a section from the pubic region showing a cluster of holocrine glands communicating with a distended hair follicle. × 52.

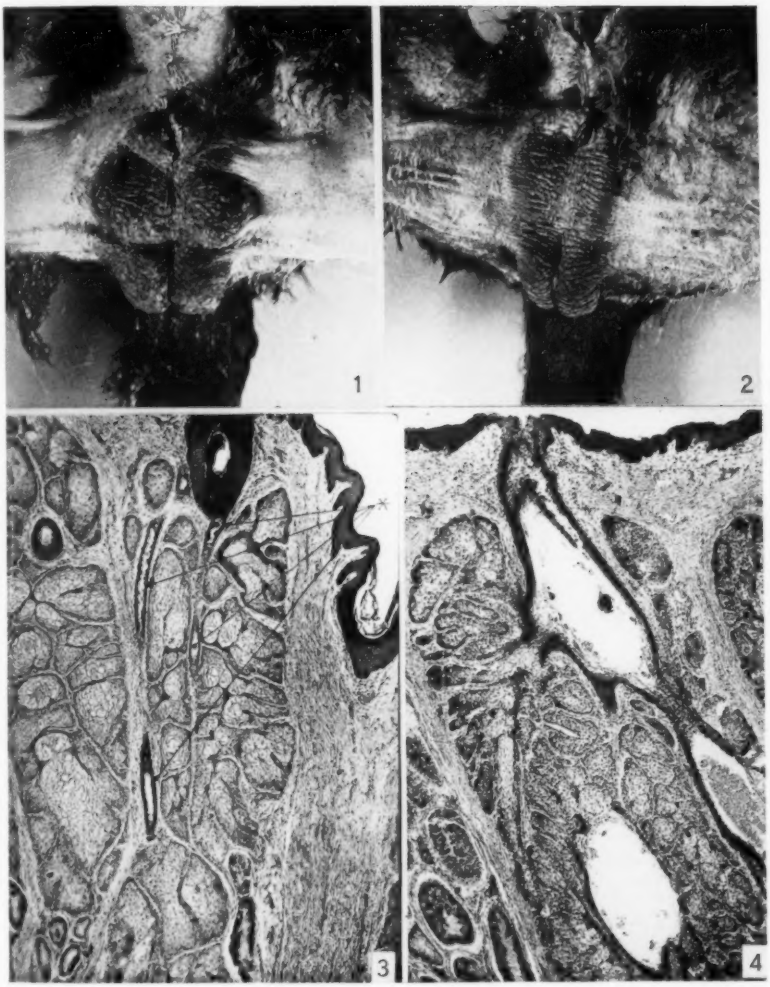
## EXPLANATION OF PLATE 23

FIG. 5. Low power view of a section through the labia majora of *Oedipomidas* showing the tremendous development of glands in that region. × 8.

FIG. 6. Low power view of the gland from the pubic region of an adult female marmoset showing the extensive glandular organ. × 8.

FIG. 7. Photograph of section from the pubic region showing holocrine glands communicating with a hair follicle. At the upper left a hair cut in cross-section. Below and predominantly to the left a large apocrine gland can be seen. × 52.

FIG. 8. Photograph of section from the pubic region of an adult male marmoset (*Oedipomidas geoffroyi*). The magnification is the same as that of the preceding figure. Note that the glandular bed is very much narrower than in the female. The holocrine glands in the male are as a rule relatively inconspicuous. In the figure a few can be seen around hair follicles near the surface. The apocrine glands, on the other hand, are well developed and distended with secretion. × 52.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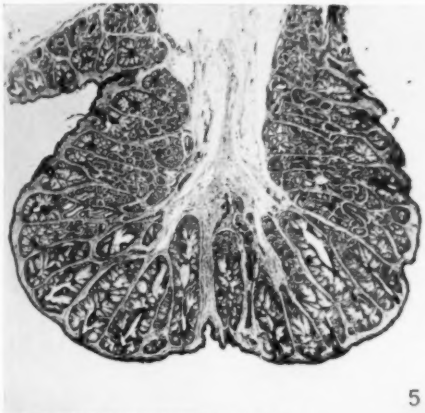

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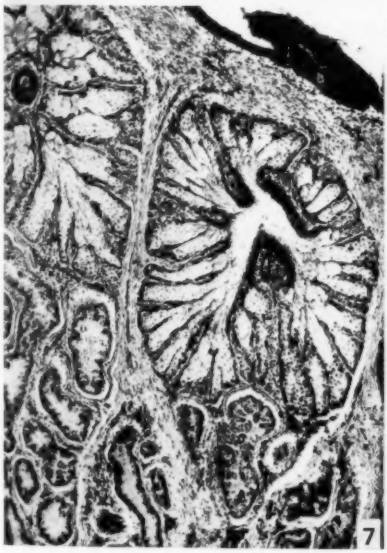

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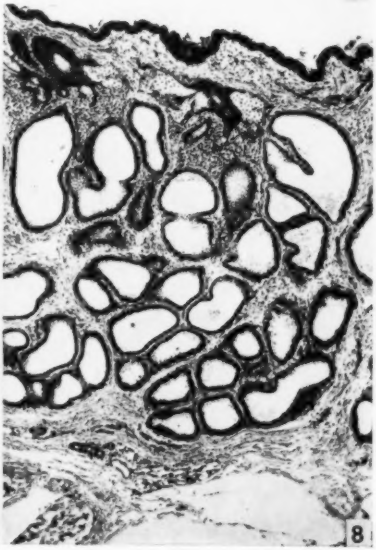

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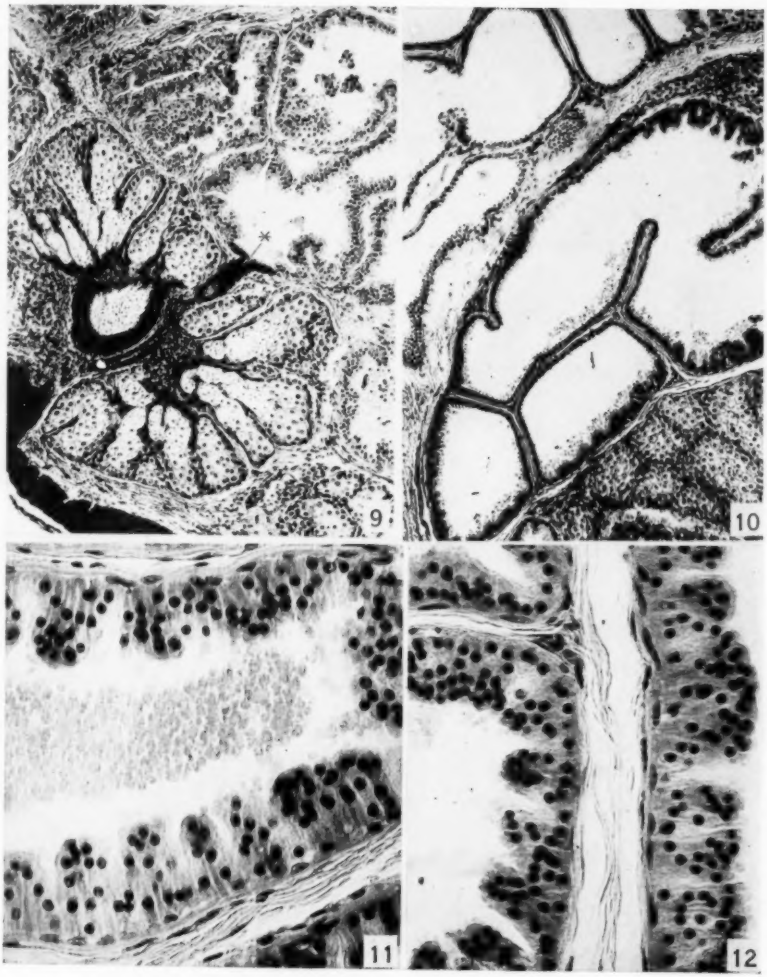


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EXPLANATION OF PLATE 24

FIG. 9. Photograph of a section from the pubic region of a female marmoset, showing both holocrine and apocrine glands. At the point marked by an asterisk, an apocrine gland drains into its duct. The transition in the character of the epithelium can be plainly seen. × 80.

FIG. 10. Photograph of a section of the apocrine portion of the genital gland from the pubic region of a female marmoset, showing a number of glands that are markedly dilated. × 80.

FIG. 11. High power view of a portion of the wall of an apocrine gland from the pubic region of a female marmoset, showing actively secreting columnar cells. In the lumen of the gland are numerous disks or plaques of secretion. × 330.

FIG. 12. Another high power view of the columnar epithelium lining an apocrine gland. × 330.

*Department of Anatomy, Johns Hopkins University.*

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## AN UNUSUAL CASE OF PARTURITION IN A BEAVER

BY ALBERT R. SHADLE

Through the kindness of J. J. Slautterbach and the Pennsylvania Game Commission, I received on April 23rd, 1928, a fine female beaver. She was pregnant and on April 28th, five days after her arrival, she weighed 53½ pounds. The animal ate well of aspen, river birch, willow, and bread. She was quite fond of bread and would eat it in preference to her regular foods but was allowed only a small amount of it per day. At first she showed a preference for white bread and did not take rye. Later she ate any kind of bread or rolls.

Thirteen days after her arrival, about 3:30 P. M. on Sunday, May 6, she dropped one beaver kit. When found about a half hour later, the mother was crouched in the typical beaver manner, with her tail turned forward under her, its ventral surface in contact with her belly. She was in fact sitting or squatting on her broad flat tail, with the kit between her tail and her body. The young beaver was crying, and when it was withdrawn from under the mother the umbilical cord and placenta were still attached to it, and the fur was quite moist, showing that birth had occurred not long before. The eyes were slightly opened and the incisors, not quite erupted, were still covered by a very thin layer of tissue.

The mother did not resent being watched and stroked, tho she had come in from the wild only two weeks before. This made it possible

to sit within three or four feet of her and watch her carefully. She soon began to work at the placenta and cord. The cord was taken into the mouth, grasped with the fore paws, and slowly drawn through the mouth. She did not eat the material promptly as many other rodents do, but continued to suck or lick the placenta and draw the cord through the mouth. During the following two hours she continued to sit hunched up with tail under her and divided her attention between cleaning the kit and eating the placenta and cord. During this time there was frequent rumbling of the bowels, and from time to time there were marked labor contractions.

In four hours two kits were born and cleaned up, and the membranes were eaten. The first weighed 371.2 grams (12 oz.) and the second one 292.5 grams (10.3 oz.).

At 8:00 P. M., the older kit was nursing so lustily that it could be heard several feet away. The mother sat dozing, occasionally gritting her teeth, while a thick, clear, syrupy liquid drooled from her mouth. Considerable activity in the flank region suggested that there were other young to be born, but at 8:25 the mother turned on her right side and both young began to nurse. By 9:30 she became more active, ate some bread and went into the water so I concluded that I must have been mistaken about there being more young.

The following morning, Monday, May 7, at 9:45, the two kits took their first swim, but the mother caught one by the side with her teeth and forepaws and took it out of the water; the other kit crawled out of its own accord. Their eyes were wide open at this time. The mother seemed rather nervous and a little inclined to belligerency, striking resounding strokes with her tail and making a blowing sound, though she made no effort to bite.

At 3:30 P. M. a third kit weighing 265 grams (9.3 oz.) and probably an hour and a half old, was found in the beaver house. On the following day, May 8, between eleven and twelve A. M., a fourth kit was born. It weighed 238 grams (8.3 oz.), and seemed rather weak and cold. This one died within about seven hours after birth, despite efforts to warm it and feed it by hand. Three hours later the largest kit was floating in the tank dead, apparently having gotten out into the tank unknown to its mother, where it swam until exhausted and then drowned. That night the mother lay or sat on a third and killed it. Thus within a period of ten hours three of the four beaver kits died. This was quite a disappointment and I decided to try to raise the fourth one by hand, rather than to leave it with the mother. At 5:00 P. M., on Wednesday,

May 9, I went to the house to take out this one remaining kit and found three, two more having been born during the afternoon. One of these kits weighed 490 grams (17.3 oz.) and the other 390 grams (13.8 oz.).

In this case the process of parturition had extended over from Sunday afternoon about 3:30 to Wednesday afternoon, a period of from 68 to 72 hours. Inasmuch as this process in rodents is usually accomplished in from a few minutes to a few hours, this fact seems worth recording. Nothing is known as to the age or previous pregnancies in this female, but from some of her reactions in caring for the young and the longer parturition period it seemed probable that this was her first litter. However, the large number of young in the litter, and her size and apparent age may indicate that she had previously borne young.

In all of the young, when examined an hour or so after birth, the eyes were slightly open and a few hours later they were completely open. The incisor teeth in all were well-formed, but were still covered with a slight layer of tissue. The weight of the young for the first day or two dropped and then began to increase steadily and rapidly.

Reports of the number of young in a litter vary from one to twelve with the suggestion of four as the usual number in a fully grown beaver of about 50 pounds. This case adds an authentic record of six kits to the litter.

*Biology Department, University of Buffalo, Buffalo, New York.*

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## A COMPARATIVE STUDY OF THE PELAGE OF THREE FORMS OF PEROMYSCUS.

By Charles S. Apgar, Jr.

[*Plate 25*]

### INTRODUCTION

In view of the interesting work done by Collins ('23) and Hausmann ('24) on the microscopic anatomy of the hair shaft, it has seemed worth while to apply their techniques, with some variation, to the study of subspecific differences of selected specimens of mice of the genus *Peromyscus*. The following is an attempt to set forth the data and conclusions obtained in such a study.

It gives me great pleasure to express here my sincere thanks and appreciation to Dr. H. H. Collins for his helpful suggestions and criticisms during the progress of the work.

## MATERIAL AND METHOD

The material consisted of two subspecies of *Peromyscus maniculatus*, and a mutant of one of them, two from California and one from Pennsylvania. The Pennsylvania subspecies was *Peromyscus maniculatus nubiterrae*, Rhoads ('03), while the forms from California were *Peromyscus maniculatus gambeli* and the yellow mutant of *gambeli*, Sumner and Collins ('23).

All of the skins used in this comparison were obtained in the fresh state with the exception of *Peromyscus maniculatus gambeli* which, however, had been prepared in the same way as the other skins. The fresh skins were stretched in order to give to the series of skins as nearly a standard condition as possible. The method employed in stretching the skins is much the same as that used by Sumner ('27) except that the weights were ten grams instead of twenty-five and there were two additional points of suspension.

The only skins used were those in the adult pelage. The skin selected was placed upon the hair selection rack whenever samples of hair were to be taken. This rack (Plate 25) consisted of a baseboard large enough to accommodate the largest skin. Upon this baseboard was hinged a piece of wire mesh with openings approximately three millimeters square. The hinging of the mesh permitted the rapid change from one skin to another. The mesh was also provided with a clamp so that it would remain in position when the skin was in place.

The hair was first pulled through the meshes of the wire at the spot desired. This was done by using a pair of small pointed forceps. Care was taken not to remove any of the hair from the skin at this time. If a single spot was selected, all the the spots bordering on it were treated in the same way, so that obtaining only the hair in that given area was made more certain. After the hair was pulled through the space in the mesh, the entire amount was removed from the space by pulling it out with the forceps.

In order to refer readily to the area from which a hair sample had been taken the columns and lines of the wire mesh were numbered. These numbers were used in labeling the preparations. In using these numbers, the column is read first, then the line, and a colon is placed between the numbers, thus "14:12."

The hair specimens thus selected were mounted in balsam on 3 × 1 inch slides and covered by 22 × 50 millimeter number 1 cover slips. In each slide, all the hairs were mounted in the same direction and were spread out as much as possible.

In order to observe the microscopic characteristics of the hair under approximately the same conditions as when the skin is viewed with the naked eye, reflected light was employed. This was thought to be advisable because the air spaces in the hair shaft appear dark in transmitted light and silvery in reflected light. The use of the ordinary Abbe condenser with a central stop was found quite adequate. A one-fifth inch objective and a 21 diameter eyepiece were used for the observations. With a 250-watt electric globe as the source of illumination, the binocular viewing machine known as the Euscope was employed with great success.

When counting the number of hairs from a given area, the mounted slide was kept in motion across the field by the mechanical stage, the hairs being counted as they moved into the field.

In measuring the lengths of the terminal bands the opaque screen of the Euscope was first measured and this figure, divided by the magnification of the image at the screen, gave the size of the projected field. The tips were thus projected upon an object of known length, making their measurement a matter of observation only.

## SUBSPECIFIC DIFFERENCES IN THE PELAGE

One of the factors determining the species of the genus *Peromyscus* is the general color tone of the pelage. The general color tone of the three forms is quite different. *P. m. nubiterrae* is described by Osgood ('09) as follows: "Sides of the body, head, and shoulders russet, thickly sprinkled with blackish, producing a gerneral effect approximating Prout brown; back from the shoulders to the base of the tail broadly blackish brown, sparingly relieved with russet; underparts pure creamy white entirely dominating the slaty basal color; ears dusky, rather sharply edged with whitish; small white at the anterior base of the ears; a narrow dusky orbital ring and spot at base of whiskers; feet white, 'ankles' dusty; tail dusky brownish above, white below." This description corresponds with the color of the local form of *P. m. nubiterrae* except that the ears are not sharply edged with whitish and there are no small white hairs at the anterior bases of the ears.[1]

The subspecies *P. m. gambeli* is described by Osgood ('09) as ochraceous buff on the upper parts, heavily mixed with dusky, the general color ranging from rusty isabella to bister (Ridgway '12), the sides being nearly or quite like the back. This gives to the *gambeli* mouse a much lighter

[1] It would seem not impossible that the specimens here discussed are *Peromyscus leucopus noveboracensis*, and not *P. m. nubiterrae*.—Ed.

color tone than that of the preceding subspecies, and also suggests the absence of a dorsal stripe in the latter.

The yellow mutant of *gambeli* is much lighter on the sides and back than either of the other two subspecies. The great reduction of the dusky leaves the yellow much more in evidence. The venter is white, as it is in the other two subspecies.

As Collins ('23) has demonstrated, members of the genus *Peromyscus* possess seven hair types, i.e., the soft downy under fur; the longer, larger and less numerous overhair; the hair of the tail; the vibrissae or mystacial hair; the supraorbital cilia; the hair of the ears; and the hair of the feet.

Table 1 shows that, of these hair types, the underhairs of the dorsum greatly exceed the overhairs of the dorsum in number in all three forms. Though the number of animals represented in the table is hardly ade-

TABLE 1

| SUBSPECIES | OVERHAIR | UNDERFUR | RATIO |
|---|---|---|---|
| *P. m. nubiterrae* | 314 | 3,454 | 1:11 |
| *P. m. nubiterrae* | 138 | 3,604 | 1:26.1 |
| *P. m. nubiterrae* | 127 | 3,331 | 1:24.4 |
| *P. m. gambeli* | 161 | 2,545 | 1:15.8 |
| *P. m. gambeli* yellow mutant | 8 | 2,826 | 1:353.25 |
| *P. m. gambeli* yellow mutant | 3 | 2,445 | 1:815 |
| *P. m. gambeli* yellow mutant | 2 | 2,908 | 1:1454 |

quate, the wide separation of the number of overhairs compared to the number of underhairs suggests a characteristic difference, with a consistent majority in favor of the underhairs.

The three forms showed only one difference in the structure of the dorsal underfur, and that is the medulla type, Hausmann ('24). The underfur of *P. m. nubiterrae* has the discontinuous simple ovate type of medulla. In the case of *P. m. gambeli* and the *gambeli* yellow mutant, the medullae are discontinuous compound ovate. The remaining parts of the hair are quite similar. The ventral underfur is indistinguishable in the different forms studied.

The larger and more deeply pigmented overhairs are found scattered through the body fur, toning the yellow underfur by their deeper pigmentation. This reduction of the yellow of the underfur is accomplished by the pigmentation of the terminal bands of the overhairs, and by the relative number of these bands present in a given area of

pelage. By gross observation, it can be seen that only the distal por tion of the hair shaft is responsible for the color of the pelage, since it is the only part of the hair visible when in the natural position. A *Peromyscus* skin, if split up the median line, will show the hair to be sloping caudad, the anterior hairs overlapping the immediate posterior hairs, so that only the distal half, or even less, of the hairs are visible upon the surface. This condition leaves hidden the slate gray bases typical of practically all the fur hairs. It is readily apparent, therefore, that the pigmented distal bands of the overhairs play an important part in determining the general color tone of a given subspecies.

A quantitative study of the pigmented bands of the overhairs of the specimens under observation verifies the gross observations. The tips of the overhairs from six selected areas of the pelage were examined

TABLE 2

*Terminal pigment of Peromyscus maniculatus nubiterrae*

| LOCATION | TOTAL NUMBER TIPS | TOTAL LENGTH | AVERAGE LENGTH |
|---|---|---|---|
| | | mm. | mm. |
| 14:13 | 68 | 85.57 | 1.342 |
| 14:20 | 65 | 88.30 | 1.43065 |
| 14:30 | 57 | 65.85 | 1.046 |
| 10:13 | 41 | 48.65 | 1.13325 |
| 10:20 | 33 | 38.95 | 1.375 |
| 10:30 | 50 | 48.25 | 0.965 |
| Totals..... | 31.4 | 385.57 | 1.216 |

microscopically under dark-field illumination. The application of dark-field illumination to the microscopic study of hair for statistical purposes is a change in the usual technique of the micro-investigation of hair. If the pelage of an animal is illuminated from above and from the sides, the rays reflected from the hair are responsible for the form and color of the latter. This system of lighting is the same as dark-field illumination except that very little light falls on the hair from directly above it in the case of the dark-field. The hair, however, is not made visible by transmitted light at all and therefore approaches more nearly the "natural" mode of observing the pelage in general.

Tables 2, 3, and 4 show the total number of terminal bands, and the average and total lengths of these bands on the six selected areas of one each of the three forms as viewed by dark-field illumination. The average terminal band length for each of the three forms is : *P. m.*

*nubiterrae*, 1.3737 mm.; *P. m. gambeli*, 1.3405 mm.; and the *gambeli* yellow mutant, 1.905 mm. By comparing the number of tips and the average length of the tips in Tables II, III and IV, respectively, it will be noticed that where the number of hairs bearing the terminal band is few, the terminal band becomes greater in length.

The distribution of the quantity of all hairs in each of the six selected areas in each skin is shown in table 5. This table shows that the ten-

TABLE 3

*Terminal pigment of yellow mutant of P. m. gambeli*

| LOCATION | TOTAL NUMBER TIPS | TOTAL LENGTH | AVERAGE LENGTH |
|---|---|---|---|
| | | mm. | mm. |
| 14:13 | 2 | 3.5 | 1.75 |
| 14:20 | 1 | 2.0 | 2.0 |
| 14:30 | 0 | 0 | 0 |
| 10:13 | 4 | 7.5 | 1.87 |
| 10:20 | 1 | 2.0 | 2.0 |
| 10:30 | 0 | 0 | 0 |
| Totals..... | 8 | 15.0 | 1.905 |

TABLE 4

*Terminal pigment of P. m. gambeli*

| LOCATION | TOTAL NUMBER TIPS | TOTAL LENGTH | AVERAGE LENGTH |
|---|---|---|---|
| | | mm. | mm. |
| 14:13 | 19 | 31.75 | 1.671 |
| 14:20 | 48 | 67.2 | 1.4 |
| 14:30 | 31 | 38.0 | 1.225 |
| 10:13 | 16 | 20.3 | 1.268 |
| 10:20 | 29 | 34.05 | 1.174 |
| 10:30 | 18 | 23.5 | 1.305 |
| Totals..... | 161 | 214.80 | 1.3405 |

dency in all specimens is to a slightly less thickness of hair towards the lateral line of demarkation, or the line between the ventral white and dorsal pigmented hair. It will be noticed from the totals, however, that the reverse is true in the case of *P. m. nubiterrae* No. 1 and the *gambeli* yellow mutant No. 1. It is therefore possible that if a greater number of specimens were represented this difference would be greatly reduced.

All three of these forms of *Peromyscus* possess the characteristic tail stripe, which consists of a band of short, pigmented hairs covering the dorsal and dorso-lateral areas of the tail. The remaining tail hairs are white. The pigmented caudal hairs of *P. m. nubiterrae* agree in structure with those of *P. m. gambeli* as described by Collins ('23) as well as with the *gambeli* yellow mutant. The ventral white caudal hairs show no difference in the two subspecies and the mutant.

The vibrissae or whisker hairs of *P. m. nubiterrae* are, on the whole, entirely pigmented, whereas those of *P. m. gambeli* and the *gambeli* yellow mutant tend to be more nearly pigmentless. The vibrissae of these forms are otherwise similar.

TABLE 5

*Relative number of hairs on the six selected areas for all skins*

| AREA | NUBITERRAE | | | GAMBELI | GAMBELI YELLOW MUTANT | | |
|---|---|---|---|---|---|---|---|
| | 6/1000 | 2/5000 | 3/5000 | 87-283 | A2 | P.m.g. ♀1 | P.m.g. ♀2 |
| 14:13 | 531 | 621 | 435 | 375 | 395 | 345 | 558 |
| 14:20 | 678 | 550 | 521 | 612 | 288 | 420 | 712 |
| 14:30 | 379 | 802 | 788 | 500 | 600 | 700 | 526 |
| Totals.... | 1,588 | 1,973 | 1,844 | 1,487 | 1,283 | 1,465 | 1,796 |
| 10:13 | 752 | 548 | 494 | 204 | 695 | 232 | 328 |
| 10:20 | 479 | 524 | 442 | 449 | 348 | 268 | 354 |
| 10:30 | 635 | 559 | 651 | 506 | 580 | 380 | 430 |
| Totals.... | 1,866 | 1,631 | 1,687 | 1,658 | 1,836 | 880 | 1,112 |

The difference between the characteristics of the ear hairs of *P. m. gambeli* as described by Collins ('23) and of *P. m. nubiterrae* is that, in the latter the longer hairs on the anterior margins possess a well marked discontinuous simple ovate medulla with dense masses of medullary pigment, Hausmann ('24). This is just the converse of the structural condition of the similar parts of the hair of *P. m. gambeli*. The cortical pigment, however, seems to be similar in its distribution. The ear hair of the *gambeli* yellow mutant corresponds in structure with that of *P. m. gambeli* and so differs in similar respects to the structure of *P. m. nubiterrae*. The long white ear hairs described by Collins for *P. m. gambeli* and also found on the *gambeli* yellow mutant are absent in *P. m. nubiterrae*. The remainder of the hairs on the pinna of the ear are

structurally similar to those described for *P. m. gambeli* but possess more cortical pigment, thus giving them a darker appearance.

The foot hairs of *P. m. nubiterrae* are nearly the same as those of *P. m. gambeli* and the *gambeli* yellow mutant (Collins, '23). The only difference is that the former possess medullary pigment in sufficient quantity to give to the hair a very slight dusky appearance in comparison with *P. m. gambeli* which is pigmentless and therefore white.

Mention has been made of the very few individuals included in these comparisons, but there are other factors that may also influence the final interpretation of the results. These are: The effect of fading and abrasion, and the seasonal variation. Regarding the former I can but quote Collins ('23), "As a rule changes in color due to fading and abrasion are slight." As to the latter the same authority continues, "The color differences observed within a subspecies . . . . cannot be ascribed to seasonal changes through which any individual may pass during the year." It is altogether possible, however, that in a microscopic investigation such as described in the present paper, very slight effects of abrasion and fading would influence the results obtained.

## CONCLUSIONS

1. Individual hairs of the underfur of *P. m. nubiterrae* differ from those of *P. m. gambeli* and the *gambeli* yellow mutant in the medulla type. *P. m. nubiterrae* possesses a discontinuous simple ovate medulla in comparison to the discontinuous compound ovate medulla type possessed by both *P. m. gambeli* and the *gambeli* yellow mutant.

2. The pigmented terminal bands of the overhairs of *P. m. nubiterrae* are about equal in their average length to those of *P. m. gambeli* and the *gambeli* yellow mutant.

3. The main difference between these subspecies is the relative number of overhairs in a given area. (See ratios—table 1.)

4. Taken in the order of the abundance of pigmented overhair tips, *P. m. nubiterrae* stands first, *P. m. gambeli* second, and the *gambeli* yellow mutant third.

5. The caudal hairs, both pigmented and white, are essentially the same in all three forms.

6. Subspecific differences of the vibrissae are slight, the only thing significant being the tendency toward more numerous pigmented vibrissae in *P. m. nubiterrae* in contrast to the more numerous pigmentless vibrissae of *P. m. gambeli* and the *gambeli* yellow mutant.

7. Ear hairs of *P. m. nubiterrae* show a marked contrast to those of *P. m. gambeli* and the *gambeli* yellow mutant, especially in the longer hairs at the anterior margin of the pinna of the ear. The eastern subspecies has, in this case, a prominent discontinuous simple ovate medulla with dense masses of medullary pigment. This is just the converse of the structure of the corresponding hair in the California subspecies.

8. The foot hairs of these forms do not give evidence of any marked subspecific differentiation with the exception of the presence of medullary pigment in sufficient quantities to correspond to the color tone of the respective subspecies—the more abundant this pigment, the darker the subspecies.

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*Department of Zoology, University of Pittsburgh.*

# A NEST OF THE CALIFORNIA GRAY SQUIRREL (SCIURUS GRISEUS)

By C. Hart Merriam

[*Plate 25*]

The big bushy-tailed Gray Squirrel of the Coast Belt of middle and northern California is a common resident of the mixed forests of redwood, Douglas spruce, tan-oak, the colorful madrone, and the tree of spicy fragrance variously called laurel, bay, or pepperwood (genus *Umbellularia*). In the forests of Marin, Sonoma, and Mendocino Counties their large leafy nests are common in oaks and less plentiful in Douglas spruce and other trees.

A nest collected by me on my place at Lagunitas in Marin County on June 23, 1925, was among the topmost branches of a living tan-oak (*Quercus densiflora*) about 45 feet from the ground. With its outer covering of leaf-bearing twigs of the tan-oak, neatly bitten off and rather loosely attached, it formed an irregular mass about two feet in diameter and three in height. Inside of this protecting mass of twigs and leaves was the nest, a roughly subglobular structure eleven by fourteen inches in diameter, consisting wholly of bark of the redwood tree (*Sequoia sempervirens*). The outer and coarser part, torn from the branches and often bearing patches of tree lichen, consisted of thin strips a foot or two in length, varying from a quarter of an inch to a full inch in width at the broad end but soon torn into slender thin streamers, many of which were again subdivided.

Within this outer covering was the living chamber, a cavity little more than five inches in diameter, consisting of and lined with finely shredded inner bark of the redwood, the shreds as fine as the finest grass and intermixed with a soft compact felting of the same material. The lower part of this felting forms a base or platform approximately 9 by 11 inches in diameter and an inch in thickness, supporting the inner chamber and forming a substantial vestibule on which the mother and young may rest.

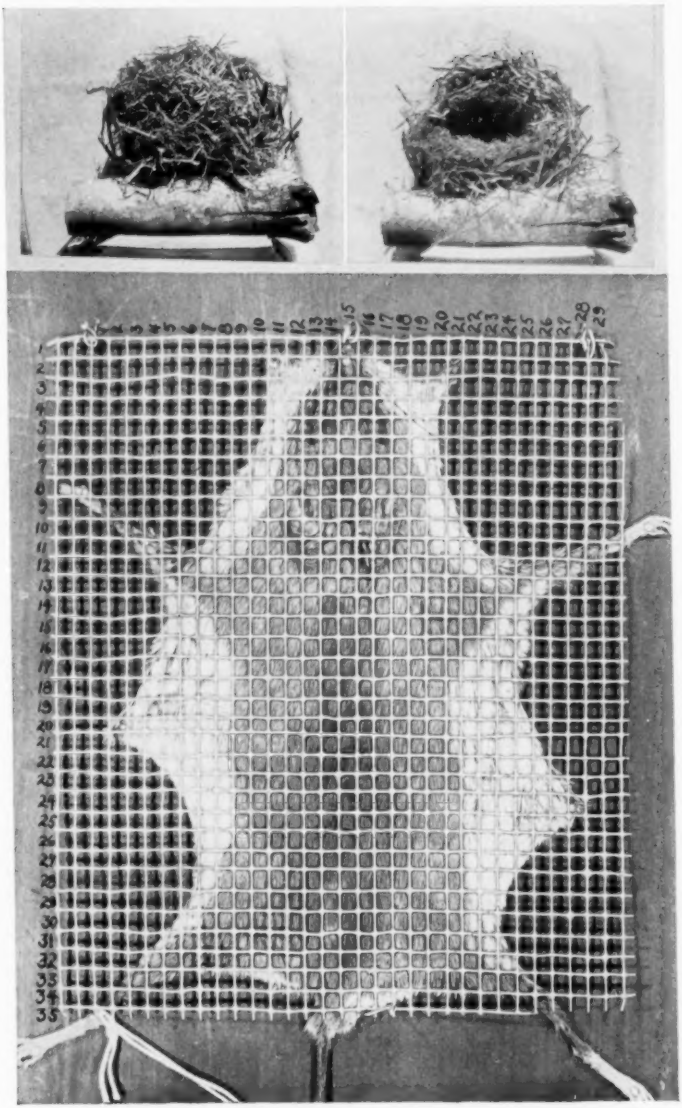
Thus the nest may be described as consisting of four parts:

1. A rough outer covering of oak leaves and twigs (not shown in the photographs).

2. The nest proper, of long strips of redwood bark (fig. 1).

3. The inner chamber of finely divided inner redwood bark (fig. 2; entrance enlarged to show nest chamber).

4. The felted base extending as a vestibule, also of finely divided and compacted redwood bark.



UPPER—NEST OF THE CALIFORNIA GRAY SQUIRREL
LOWER—HAIR SELECTION RACK

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# BIRTH OF THE YOUNG OF MYOTIS AUSTRORIPARIUS

By H. B. Sherman

[*Plate 26*]

Information concerning young bats is meager and the only account of parturition among the Microchiroptera which I have come across is that of Rollinat and Trouessart[1] who record a single birth of *Vespertilio murinus* Schreber. Likewise their description of the new-born young is the only satisfactory one of which I am aware. The recent recognition of *Myotis austroriparius*, the small numbers of specimens in collections[2] and a consequent lack of knowledge concerning their habits combine to make the birth of the young and related phenomena of unusual interest.

Frequent visits were made to an old building in Gainesville, Florida, during the spring of 1929. The first was on March 23 for the purpose of collecting specimens of *Tadarida cynocephala* which regularly roost in this place. It is unusually easy to collect and observe the bats in this situation and all that were in accessible positions were examined on each visit. On April 23 a cluster of about twenty *Myotis austroriparius* was found clinging to a rafter among the *Tadarida*. On subsequent visits when *Myotis* were observed they were either in this same spot or not more than ten feet from it.

Four individuals captured in a net and carried to the laboratory alive, as were all of the specimens collected, proved to be males.[3] April 25 the cluster had increased in size and was estimated to contain fifty individuals. April 29 and May 2 about fifteen were hanging singly among the *Tadarida*. May 4 a cluster of about thirty was found in the original place. May 7 they were again more or less scattered and on May 10, 12 and 14 many adults and young were present in a series of crevices between vertical boards that formed the top of a partition of the building. May 18 none could be found and a single individual was seen May 21, 23, 28, 29, and June 1. June 15 an adult female, probably the same individual, was captured. A cluster of about 25 was observed in the original location on June 25 and 29; one only July 5; about 50, July 13;

[1] 1896. Sur la Reproduction des Chauves-Souris. Mem. de la Societe Zoologique de France, T. IX, pp. 214–240.

[2] Miller and Allen, Bull. U. S. Nat. Mus. No. 144, 78, 1928.

[3] I am indebted to the Bureau of Biological Survey, U. S. Dept. of Agriculture, for checking the identification of specimens of this series.

and from 100 to 200, October 17, 24, November 5, 18, December 3, and January 6.

Other duties made it impossible for me to prepare all of the specimens collected on certain days and those left over were kept alive in hardware-cloth cages. A female, No. 430,[4] collected May 2 and etherized May 4, was apparently giving birth to a young when killed although this was not discovered until the foetus was removed for preservation. Another female, No. 450, captured May 4, gave birth to a young May 7 when the young was found dead in a somewhat dried condition sprawled out on the floor of the cage at 5:40 P.M. Part of the afterbirth was being extruded at this time and was being licked and chewed by the mother. It was obvious that a second young was about to be born and the process was completed, under observation, five minutes later. It was enclosed in the amnion and as soon as born its umbilical cord was severed by the teeth of the mother and it also dropped to the floor of the cage, apparently dead when born. A placenta[5] appeared two minutes later and was pulled out by the teeth of the mother and eaten.

On May 8, No. 449, which had been captured the previous day, gave birth to a young one between 1:30 and 2:00 P.M. I tried to feed her an insect at 1:30 P.M. when she appeared normal; and when she was again observed at 2 o'clock the offspring, which was quite wet, was vigorously squirming about apparently in search of a teat. The mother was licking it and although it appeared to be strong, it uttered no sounds as did some of the other newly born young observed. The umbilical cord was still attached and the placenta had not appeared.

At two o'clock and for a considerable time thereafter, the mother was hanging from the under side of the top of the cage by rather widely spread feet and by her thumbs. The base of the tail was curved strongly dorsally, the distal half strongly ventrally, and as the wings were slightly spread, the interfemoral and alar membranes formed a receptacle in which the young crawled about as far as the length of the cord would permit.

A second young was born from 2:10 to 2:15 P.M. It appeared tail end first, enclosed in the amnion and with its ventral side towards that of the mother. When about a quarter born, the amnion was torn by the teeth of the mother and a minute later the offspring popped out into

[4] Numbers refer to specimens in my collection.

[5] The placenta in this species is discoidal in shape and antimesometric in attachment. When two embryos were present one was in either uterus. When only one was present it was in the right horn.

the curled up interfemoral membrane. During this time the first born had become attached to the left breast and as soon as the second was born it crawled about and became entangled with the first, at which time one or both of the young uttered weak squeaks of a nasal quality. These notes were frequently heard later whenever the young were disturbed. This tangled condition of the young persisted for half an hour during which time they were licked by the mother. She then pushed the second born with her head and it quickly became attached to the right breast, apparently nursing. The first born apparently retained its position on the left breast continuously after its first attachment and both became quiet.

The mother retained her position after the young became quiet, but occasionally crawled a few inches in a lazy fashion and also occasionally licked the discharge from the vaginal orifice, until 3:30 P.M. when she hung herself up on one side of the cage in the typical bat position, with a young one under the base of each wing. The young one on the right side was not attached to a breast at this time but the other apparently was. Both were quiet. The mother closed her eyes and apparently went to sleep. She remained in this position until at least 5 P.M. when I left the laboratory.

I returned at 6:10 P.M. and at this time both young were still attached by their umbilical cords which were now white instead of pink as at the time of birth. At 6:20 P.M. the placenta of the young attached to the right side of the mother appeared and was pulled out by the teeth of the mother and eaten. Ten minutes later the other placenta was likewise consumed. In each case about a quarter of an inch of the cord was left attached to the young.

They were weighed at 9 P.M. of the same day, the young weighing 1.10 and 1.15, and the mother 7.25 grams. The mother had been without food or drink since her capture the previous day.

While collecting specimens at 8:45 A.M. on May 10, a female, No. 455, was found with one young attached by the cord. She was hanging head down from the side of a vertical partition of rough boards, by her feet and thumbs, but with the rear part of the body held as far from the partition as possible. The wings were slightly spread and the tail was curved as in the case of No. 449, described above. I missed her with the first stroke of the net and she took flight, the young one dangling by the cord. I captured her a moment later, and when she was examined in the laboratory at 9:05 A.M. two young were found, each attached by its cord. It was impossible to continue observations at this time

and she was placed in a cage in a much frightened condition where she flew and rapidly crawled about on all fours. One of the young was suspended only by the cord at this time, the other clinging to the mother with teeth and claws, and upon my return two hours later one of the young was found dead on the floor of the cage with the umbilical cord broken, an accident which had caused it to lose blood. The other young was attached to the right breast and on the three succeeding days, on the occasions when it was found attached to the mother it was always attached to the same side.

At 8:30 A.M. of May 12, No. 458, captured May 10, had given birth to two young. One was attached to a nipple and the other appeared to be in search of one. They remained attached by the cords until 2:30 P.M. when the two placentas appeared at short intervals and were pulled out and eaten as already described. Again at this time only one of the young was attached to a breast, but when I pushed the other in place it began at once to nurse. The mother escaped during the night leaving the two young in the cage, which had been left open.

Another specimen, No. 457, also captured May 10, was apparently in labor at 8:30 A.M. May 12 and a small amount of a white discharge was noticed at the vaginal orifice. Probably the amniotic fluid had also been discharged, as her ventral surface was wet and was being licked. When the young were born the amnion clung to them in shreds and was not torn by the mother's teeth at the time of birth. At 8:50 A.M. the elbow of the foetus projected about an eighth of an inch and parturition did not progress much in the next half hour. The mother was probably weak, as she had not accepted food or water during her two days of captivity. Possibly the early rupture of the amnion may also have been the cause for the slow progress. Labor lasted for only a few seconds at a time and alternated with rest periods that varied from 20 to 90 seconds. At 11:47 A.M. the hind quarters of the young were suddenly protruded and at 12:15 P.M. the head came out. One wing remained unborn and was pulled out with forceps. The young then began to crawl weakly about and was licked by the mother.

During parturition she had been hanging in essentially the same position as No. 449, described above, but at 12:35 P.M. she relinquished her hold by the thumbs to hang head down. The young then appeared to be supported only by the cord, which was just long enough to bring its head to the level of the breast where it began to nurse. Four minutes later the mother again hung up by her thumbs as well as her feet, and the second young appeared. At 12:55 P.M. she again hung head down

and the young projected about an eighth of an inch. Five minutes later it was about half born. Subsequent progress was very slow and at 2:07 P.M. the second young was pulled out with forceps. This pull may or may not have dislodged the placentas. At any rate they appeared immediately and both young and mother were etherized and preserved in formalin. (Pl. 26, figs. 3 and 4.) The length of the umbilical cords in these specimens is 14 mm. each, after having been preserved in formalin.

Specimen No. 469, collected at 4 P.M., May 14, had two young clinging to her and was eating a placenta at the time of capture. This is the latest date on which newly born young were observed.

At birth, the young are naked except for a few vibrissae, some hairs on the toes and a few in the region of the knees. The ears and eyes are closed and they have a blackish color, although the transparency of the skin adds a pinkish hue. The tips of the ears of young that lived in captivity became free and stood out from the head from one to two days after birth. Other young captured and estimated to be a week old had their eyes open.

Attempts were made to feed specimens which were kept captive. Insects of various kinds were offered them with forceps, and water was given them with a pipette. These attempts were only moderately successful and there can be no doubt that the animals were undernourished. Much individual variation was noticed in regard to the types of insect food accepted and also in the ease with which certain individuals were induced to snatch an insect from the forceps. Several refused all food and water offered, others refused on the evening after capture but accepted the following evening and a few accepted both food and drink shortly after capture. Specimen No. 450 was fed most easily and learned to come to any part of the cage where the forceps grated on the wire mesh. On May 8 she was fed ninety small insects which were found on the screened windows of the laboratory, without apparently satisfying her appetite. These included pentatomids, leaf-hoppers, mosquitoes, craneflies, other Diptera, moths, and small beetles. Small portions of crickets (*Gryllus* and *Ceuthophilus*) and grasshoppers were accepted by this and other individuals. Another specimen refused a moth that No. 450 ate greedily and also ate a certain beetle that No. 450 had several times refused. It was also noticed that the choice of food changed from night to night with the same individual.

All but one of the mothers with young born in captivity were kept alive for a few days. In the morning the young were usually not at-

tached to their mothers but were hanging on the cage close by. At first I interpreted this as being evidence that the mothers were too

TABLE 1

*Measurements of adult females*

| CATALOG NUMBER | HEAD AND BODY | TAIL | TIBIA | FOOT | FOREARM | THUMB | THIRD METACARPAL | FIFTH METACARPAL | EAR FROM MEATUS | WEIGHT OF ENTIRE SPECIMEN | WEIGHT OF EMBRYOS IN UTERO | NUMBER OF EMBRYOS | DATE COLLECTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 406 | 53.0 | 40.0 | 16.5 | 10.3 | 39.5 | 6.5 | 35.3 | 32.3 | 14.0 | 8.8 | .... | 1 | April 25, 1929 |
| 407 | 56.0 | 44.0 | 17.3 | 11.0 | 41.7 | 7.0 | 38.3 | 37.0 | 13.5 | 10.4 | .... | 2 | April 25, 1929 |
| 408 | 57.0 | 41.0 | 17.6 | 11.0 | 40.1 | 6.5 | 36.0 | 34.0 | 14.0 | 10.2 | .... | 2 | April 25, 1929 |
| 409 | 57.0 | 37.0 | 17.2 | 10.2 | 38.8 | 6.1 | 35.0 | 34.2 | 13.0 | 9.8 | 1.5 | 2 | April 25, 1929 |
| 410 | 50.5 | 38.5 | 15.9 | 11.0 | 37.0 | 6.0 | 35.3 | 33.6 | 13.0 | 8.3 | 1.5 | 2 | April 25, 1929 |
| 411 | 52.0 | 41.0 | 17.5 | 11.0 | 38.9 | 7.0 | 35.2 | 33.2 | 13.0 | 7.2 | .... | 1 | April 25, 1929 |
| 412 | 48.0 | 41.0 | 15.5 | 11.0 | 36.8 | 7.0 | 33.2 | 31.8 | 12.5 | 7.1 | .... | 1 | April 25, 1929 |
| 413 | 48.0 | 39.0 | 16.6 | 10.5 | 37.8 | 6.5 | 33.9 | 31.4 | 13.5 | 7.7 | .... | 1 | April 25, 1929 |
| 414 | 49.0 | 41.0 | 16.8 | 11.0 | 40.6 | 7.0 | 37.0 | 34.5 | 13.5 | 10.0 | .... | 2 | April 25, 1929 |
| 415 | 51.0 | 41.0 | 16.3 | 11.0 | 38.2 | 6.8 | 34.3 | 32.5 | 14.0 | 8.5 | .... | 2 | April 25, 1929 |
| 416 | 50.0 | 40.0 | 16.6 | 11.0 | 37.8 | 6.5 | 35.6 | 32.2 | 13.1 | 8.9 | .... | 2 | April 25, 1929 |
| 417 | 45.0 | 39.0 | 14.8 | 10.5 | 35.6 | 6.0 | 32.0 | 31.3 | 12.8 | 7.1 | .... | 1 | April 25, 1929 |
| 418 | 55.0 | 43.0 | 16.7 | 11.0 | 39.0 | 6.5 | 35.6 | 34.0 | 13.4 | 10.25 | 2.4 | 2 | April 29, 1929 |
| 419 | 52.0 | 42.0 | 16.0 | 11.2 | 38.5 | 6.5 | 33.2 | 31.5 | 13.5 | 9.27 | 2.1 | 2 | April 29, 1929 |
| 428 | 55.0 | 38.5 | 16.0 | 11.1 | 37.3 | 6.6 | 36.0 | 35.0 | 13.4 | 10.7 | 3.3 | 2 | May 2, 1929 |
| 429 | 52.0 | 39.0 | 15.8 | 11.0 | 37.6 | 7.4 | 35.8 | 33.8 | 13.4 | 9.2 | 1.4 | 1 | May 2, 1929 |
| 430 | 50.0 | 40.0 | 14.6 | 10.8 | 37.1 | 6.8 | 34.1 | 32.7 | 14.2 | 7.45 | 1.35 | 1 | May 2, 1929 |
| 433 | 55.0 | 39.0 | 15.6 | 10.9 | 38.6 | 7.5 | 34.5 | 33.9 | 14.0 | 10.2 | 2.55 | 2 | May 4, 1929 |
| 435 | 52.0 | 40.0 | 16.4 | 11.4 | 38.2 | 7.2 | 34.8 | 34.0 | 13.4 | 8.6 | 2.3 | 2 | May 4, 1929 |
| 436 | 54.0 | 40.5 | 16.1 | 11.3 | 37.6 | 6.4 | 36.4 | 34.2 | 15.4 | 9.67 | 2.6 | 2 | May 4, 1929 |
| 437 | 55.0 | 39.0 | 15.6 | 12.0 | 40.6 | 8.1 | 36.0 | 34.5 | 13.9 | 8.65 | 2.5 | 2 | May 4, 1929 |
| 438 | 55.4 | 39.0 | 16.7 | 12.5 | 39.0 | 7.3 | 35.9 | 34.4 | 14.2 | 9.88 | 2.85 | 2 | May 4, 1929 |
| 444 | 50.0 | 39.0 | 16.8 | 11.8 | 38.0 | 8.0 | 34.7 | 33.4 | 14.4 | 8.7 | .... | 1 | May 7, 1929 |
| 449 | 52.0 | 38.0 | 16.6 | 11.6 | 37.5 | 7.6 | 36.0 | 33.3 | 13.2 | 10.0 | 2 young | | May 7, 1929 |
| 450 | .... | .... | .... | .... | .... | .... | .... | .... | .... | ..... | 2 young | | May 4, 1929 |
| 455 | 52.0 | 43.0 | 17.3 | 11.0 | 38.2 | 7.0 | 35.5 | 35.0 | 14.4 | 5.4 | 2 young | | May 10, 1929 |
| 457 | 53.0 | 40.0 | 16.4 | 11.0 | 38.6 | 7.0 | 35.5 | 33.5 | 12.6 | ..... | 2 young | | May 10, 1929 |
| 469 | 51.0 | 39.0 | 17.5 | 11.0 | 40.4 | 7.3 | 37.5 | 37.0 | 15.0 | 7.0 | 2 young | | May 14, 1929 |
| 470 | 48.0 | 40.0 | 17.3 | 11.0 | 38.3 | 7.2 | 34.6 | 33.9 | 14.0 | 6.0 | .... | .... | May 14, 1929 |
| 576 | 52.0 | 39.0 | 16.5 | 11.1 | 39.1 | 7.6 | 35.7 | 34.4 | 14.0 | 6.55 | .... | .... | June 15, 1929[6] |

undernourished to care for them, but observations at the building where all were captured showed that the adults and young often hang separately during the day. The young thus observed varied in age from a few

[6] In rigor mortis.

hours to probably a week. Mr. O. C. Van Hyning, of the Florida State Museum, who chanced to make some independent observations on this

TABLE 2

*Measurements of adult males*

| CATALOG NUMBER | HEAD AND BODY | TAIL | TIBIA | FOOT | FOREARM | THUMB | THIRD METACARPAL | FIFTH METACARPAL | EAR FROM MEATUS | WEIGHT | DATE COLLECTED |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 402 | 53.0 | 40.0 | 16.0 | 10.2 | 38.3 | 6.5 | 33.4 | 33.0 | 13.0 | 6.5 | April 23, 1929 |
| 403 | 52.5 | 38.5 | 16.0 | 10.2 | 38.5 | 6.0 | 32.5 | 31.0 | 14.0 | 6.6 | April 23, 1929 |
| 404 | 51.0 | 39.0 | 15.9 | 10.6 | 38.0 | 6.5 | 33.0 | 32.0 | 13.5 | 6.5 | April 23, 1929 |
| 405 | 50.5 | 36.5 | 15.6 | 10.0 | 35.5 | 6.0 | 31.7 | 30.5 | 14.0 | 5.7 | April 23, 1929 |
| 420 | 49.5 | 40.5 | 16.3 | 11.0 | 38.0 | 6.9 | 34.5 | 32.8 | 13.6 | 5.65 | April 29, 1929 |
| 421 | 49.5 | 38.5 | 15.5 | 10.0 | 36.4 | 6.6 | 33.4 | 31.0 | 14.0 | 5.5 | April 29, 1929 |
| 431 | 51.5 | 39.0 | 16.3 | 11.0 | 39.5 | 7.5 | 35.0 | 34.0 | 14.5 | 5.8 | May 2, 1929 |
| 434 | 49.5 | 37.0 | 15.6 | 11.0 | 35.7 | 7.3 | 32.6 | 31.3 | 14.2 | 5.35 | May 4, 1929 |
| 447 | 51.0 | 39.0 | 15.9 | 11.2 | 37.3 | 7.2 | 34.5 | 33.2 | 13.8 | 6.4 | May 7, 1929 |
| 448 | 51.0 | 44.0 | 16.7 | 11.0 | 39.0 | 7.5 | 36.0 | 33.0 | 13.8 | 6.4 | May 7, 1929 |
| 451 | 51.0 | 39.0 | 17.3 | 11.0 | 37.5 | 8.0 | 34.0 | 32.6 | 12.6 | 5.5 | May 7, 1929 |

TABLE 3

*Measurements of young*

| CATALOG NUMBER | HEAD AND BODY | TAIL | TIBIA | FOOT | FOREARM | THUMB | THIRD METACARPAL | FIFTH METACARPAL | EAR FROM MEATUS | DATE BORN |
|---|---|---|---|---|---|---|---|---|---|---|
| 445 | 25.5 | 11.5 | 6.5 | 8.9 | 9.8 | 5.5 | 7.0 | 7.6 | ... | May 7, 1929; ♀ newborn[6] |
| 454 | 26.0 | 13.0 | 7.5 | 8.1 | 11.2 | 5.8 | 7.9 | 8.5 | ... | May 10, 1929; ♂ newborn[6] |
| 459 | 29.0 | 14.0 | 7.2 | 9.0 | 11.0 | 6.0 | 7.7 | 8.0 | ... | May 12, 1929; ♂ 1 day old |
| 460 | 26.5 | 13.0 | 7.2 | 9.0 | 10.5 | 6.0 | 7.7 | 8.0 | ... | May 12, 1929; ♀ 1 day old |
| 466 | 29.0 | 14.0 | 7.4 | 9.0 | 11.2 | 6.2 | 7.6 | 8.4 | 6.9 | May 14, 1929; ♂ 1 day old |
| 467 | 31.0 | 10.0 | 7.4 | 9.0 | 11.2 | 5.8 | 7.5 | 8.5 | 5.8 | May 14, 1929; ♂ 1 day old |
| 452 | 27.8 | 12.0 | 7.2 | 8.8 | 10.3 | 6.3 | 7.5 | 8.4 | ... | May 8, 1929; ♂ 2 days old |
| 453 | 28.0 | 13.0 | 6.8 | 9.0 | 10.8 | 6.5 | 7.0 | 7.5 | ... | May 8, 1929; ♀ 2 days old |
| 456 | 27.0 | 13.0 | 6.7 | 9.0 | 11.7 | 6.0 | 8.0 | 8.5 | 4.7 | May 10, 1929; ♂ 3 days old[6] |
| 465 | 33.0 | 16.0 | 9.3 | 9.5 | 14.9 | 6.0 | 9.0 | 11.0 | 7.5 | |
| 468 | 38.0 | 18.0 | 10.3 | 10.5 | 18.2 | 6.0 | 11.5 | 12.0 | 8.0 | |

same colony at about 8:30 P.M. told me that many young were present at this time, although adults of this species were not seen. Several adult *Tadarida*, however, were in their vicinity.

[6] In rigor mortis.

The surviving young of No. 455 was attached to its mother on the several occasions when it was observed on the day of its birth and capture, but the next morning they were hanging separately from the side of the cage. The young one appeared to be well nourished and contented. Later in the morning the mother placed her right wing over it and it became attached to her breast. The same procedure was observed the following morning.

Measurements were made immediately after the specimens were etherized and before rigor mortis had set in, unless otherwise specified. The total length, length of tail, foot and thumb were taken direct on a ruler graduated in millimeters. Length of tibia and forearm were taken with vernier calipers, and the length of the ear and metacarpals were taken with dividers and a ruler graduated to half millimeters. The average length of the tail, foot and thumb of adults is noticeably greater than corresponding figures published by Miller and Allen (*loc. cit.*, p. 80.), which may possibly be explained by the freshness of the specimens here listed while being measured. Other external characters agree well with the description given by Miller and Allen. All available figures show that males average slightly smaller than females.

All of the young which were not measured in rigor mortis were captives for at least a day and hence their measurements may not correspond exactly with others which lived under normal conditions.

## SUMMARY

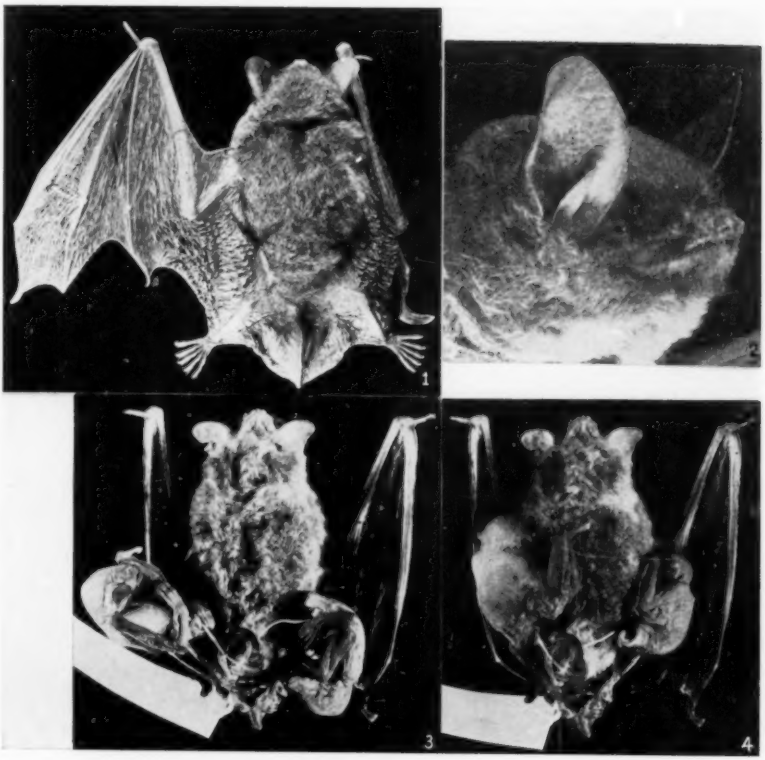
1. *Myotis austroriparius* (Rhoads) were present in considerable numbers in an old building at Gainesville, Florida.

2. Evidence of parturition was observed from May 4 to May 14.

3. During parturition the mother assumed such a position that the interfemoral and alar membranes formed a receptacle in which the young crawled about as soon as born.

4. Except in cases when the young were born dead or in which the amnion was ruptured before birth, the placenta did not appear until several hours after birth. At this time it was pulled out by the teeth of the mother and eaten, about a quarter of an inch of the cord being left attached to the young.

5. The length of the umbilical cord of two young of one individual is 14 mm. each, after having been preserved in formalin. The length of the cord is such that when the mother hung head down in an extended position and when the young appeared to be suspended only by the cord, the head of the young was on a level with the nipples.

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6. Soon after birth and before the appearance of the placenta, the young may be suspended only by the cord, when, under unusual conditions, the mother takes flight.

7. Of the seven cases of parturition observed, all occurred during the day, and none of the captives gave birth to young at night.

8. Twenty-nine females collected between April 25 and May 14 either contained embryos or had recently given birth to young. Twenty-one of these had either an embryo in each uterus or two young. The other eight contained a single embryo in the right uterus.

9. At birth the young are naked except for a few vibrissae and a few hairs on the toes and about the knees. The ears and eyes are closed and except for the transparency of the skin which gives them a pinkish hue, they are black.

10. The tips of the ears of young kept in captivity became free and stood out from the head from one to two days after birth, and young captured and estimated to be a week old had their eyes open.

11. Adults were fed pentatomids, leaf hoppers, mosquitoes, craneflies; other Diptera, moths, small beetles and small portions of *Gryllus*, *Ceuthophilus*, and grasshoppers besides water. Much individual variation was observed in choice of food eaten.

12. Young apparently remained attached to their mother much of the daytime on the day of birth, but on subsequent days and nights they were attached only occasionally.

## EXPLANATION FOR PLATE 26

FIG. 1. Adult female, No. 576, reduced.

FIG. 2. Head of No. 576, about three times life size.

FIGS. 3 AND 4. Specimen No. 457 and young somewhat reduced. The placentas and umbilical cords are attached and undamaged. Figure 4 shows a rather natural position of the young, although they are preserved specimens.

# GENERAL NOTES

## FURTHER NOTES ON TOLYPEUTES

Since the appearance of my paper on the "Distribution and Habits of the Three-banded Armadillo (*Tolypeutes*), (Journ. Mamm. 1930, *11*, No. 1, pp. 61–68), three more specimens have come to light. Dr. Thomas Barbour, Director of the Museum of Comparative Zoology, was kind enough to call my attention to these specimens, and to send them to me for examination. It has been a pleasure to handle them, as two are the most important and interesting specimens of this genus in any known collection.

These two specimens (M. C. Z., Nos. 1974, 1975) are from Pernambuco, Brazil, collected by the Rev. J. C. Fletcher; one bears the date "Dec. 1863." Both are *Tolypeutes tricinctus tricinctus* (Linnaeus) and afford physical evidence of my claim that Pernambuco should be the type locality of this species. They bring the total of known specimens up to eight, and are especially interesting because they are not only the sole specimens in this country, but the only ones in the world with any definite locality.

One of the armadillos (M. C. Z., No. 1974) has the skull in the skin; the other is the carapace rolled up in the defensive position of the animal. The posterior shields each have thirteen rows of scutes, the scutes being larger and therefore fewer per row than in *T. t. matacus*. The cephalic shields agree in pattern with that given for the species, but I believe a series would show the same variation as found in *T. matacus*. The tail is depressed; there are five toes on the front feet; three rows of scutes under the eyes; and in all other respects the specimens agree with former descriptions of the species.

The other specimen (M. C. Z., No. 6312) is a mounted example of *Tolypeutes t. muriei* (Garrod), from Corte Pie, northwest of Bahia Blanca, Province of Buenos Aires, Argentina, and was purchased from H. A. Ward, of Rochester, New York. The scutes on this animal are markedly raised and tuberculated, and the shields and moveable bands are very hairy along the back. These conditions can, I am sure, be ascribed to immaturity. A good series of skulls is still necessary to prove that *muriei* is a valid subspecies. This is the fourth specimen of *muriei* known to be in collections in this country.—Colin Campbell Sanborn, *Field Museum of Natural History, Chicago, Illinois.*

## WEASEL BADLY INJURED BY KING SNAKE

While traveling on a gravel road three and one-half miles southeast of Santa Margarita, San Luis Obispo County, about ten a.m. on May 28, 1930, I was so fortunate as to witness a struggle between an adult male weasel (*Mustela xanthogenys xanthogenys*) and a king snake (*Lampropeltis getulus boylii*) three feet, five inches long. Each of these animals is now preserved as a scientific specimen in the Museum of Vertebrate Zoology.

Upon our driving past the animals, the weasel became frightened and ran into some grass some seven or eight feet away at the side of the road. When I walked back toward the scene of the struggle, the weasel had returned to the center of the road and gripped the snake on the back of the head. The weasel was being carried around, and even thrown off its feet, by the violent writhings of the reptile.

Three bullets from a pistol were fired at them from a distance of 25 yards, with no apparent attention being shown by either individual until the third shot, when the weasel acted as if struck. It loosed its hold and slowly dragged itself into the grass where it was easily caught and killed. The snake lay dead in the center of the road. The weasel had been bitten in many places on the head, neck, and body. The tough skin was cut entirely through in six places; these wounds showed plainly when the weasel was skinned, but no bullet marks were found, although they were carefully looked for. It appeared, therefore, that the snake alone had badly, if not fatally, wounded the weasel. The only marks on the snake were two small holes at the base of the skull.

The question arises which was the aggressor? It seems more likely that the weasel attacked the snake, for if the opposite were true, the weasel likely would have escaped unless it was sick, and, too, it probably would not have returned after being frightened by the car.—W. C. Russell, *Museum of Vertebrate Zoology, University of California, Berkeley, California.*

### On a long-known occurrence of a musk-ox at Natchez, Mississippi

In 1893 the writer gave an account of the finding[1] at Natchez, Mississippi, of a musk-ox now called *Symbos cavifrons*. On page 392 was presented also a list of the fossil vertebrates which had been found in Mississippi. This had been prepared by Dr. Joseph Leidy for the state geologist, B. L. C. Wailes and appeared in this official's report published in 1854.[2] Among the animals named was *Boötherium cavifrons*, this genus being then supposed to contain the species. The list was later reproduced by E. W. Hilgard.[3] In neither of these reports was it definitely stated where the species had been found nor what parts of the animals had been secured.

In 1855, in discussing *Megalonyx jeffersonii* Leidy wrote[4] as follows:

A number of bones of an adult skeleton which were discovered by Dr. M. W. Dickeson, in the vicinity of Natchez, Mississippi, associated with the remains of the *Mylodon, Equus americanus, Bootherium, Cervus, Ursus, Tapirus*, etc. They were obtained according to Dr. Dickeson, from a stratum of tenacious blue clay which underlies the drift east of Natchez. With these specimens and presenting the same general appearance of color, compactness, etc., was discovered the so-called fossil human innominate bone.

In 1870 Leidy announced[5] that a ramus of a lower jaw found in Iowa and containing only the hindmost molar had been sent to him by the Smithsonian Institution and that this appeared to belong to *Ovibos cavifrons*. This, he said was the first time that the lower jaw of this animal has been found. So far as known to the present writer, no other part of the lower jaw of this species has since that time been discovered. Mr. Barnum Brown found in northwestern Arkansas the second and third lower molars of a new species which he named *Symbos australis*.

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[1] Publ. No. 322, Carnegie Instn., Wash., D. C., p. 254.
[2] Rep. on Agricult. and Geol. Miss., p. 286.
[3] Rep. on Geol. and Agricult. Miss., 1860, p. 196.
[4] Smithson. Contr., vol. VII, art. 3, p. 6.
[5] Proc. Acad. Nat. Sci., 1870, p. 73.

It must be added that the jaw mentioned by Leidy appears to have been lost. In describing the Iowa jaw Leidy recalled[6] the Natchez tooth and stated that it would appear to belong to the same animal and he gave its measurements.

It appears now reasonably certain that the tooth found at Natchez belongs to the musk-ox *Symbos cavifrons* and that it was discovered in the tough blue clay with the other fossil animals. All of these, except two, are now extinct. The musk-ox tooth represents the most southern occurrence of any species of the subfamily Ovibovinae. It would be interesting to learn how it reached that locality. It may be taken as certain that it was during one of the glacial stages. Other specimens of the species have been discovered along the eastern border of Oklahoma and along Mississippi River in Missouri. It is possible that some herds wandered as far south as Natchez. Or possibly an unfortunate animal fell into the Mississippi and its carcass was swept down to Natchez.

It is of more importance to know when the animal met its fate. The geology at Natchez was studied[7] by Dr. W. J. McGee. He found from 25 to 50 feet of loess overlying the fossil-bearing blue clay (Port Hudson) and that the latter was from 10 to 15 feet thick. Chamberlin and Salisbury later described[8] a formation underlying this which they called the Natchez and referred to the Subaftonian (Nebraskan) and the Aftonian. They expressed the opinion that the great Mississippi trench, 60 miles more or less in breadth, had been excavated since the deposition of the Natchez. The blue clay lies between the Natchez and the loess.

The present writer has discussed[9] the age of the mammals occurring at Natchez, and expressed the view that they had been buried there not later than the Sangamon interglacial stage. Considering now the occurrence of the musk-ox and the fact that 200 feet of loess has been deposited in that region since those animals existed the writer is inclined to refer them to the Illinoian interglacial stage.

Some years ago at the Academy of Sciences of Philadelphia the writer examined the tooth found at Natchez and took some notes on it. In preparing the account mentioned at the beginning of this article the writer overlooked these notes. Since it may enable some one hereafter to identify teeth of this musk-ox the notes are now given. On the label the tooth is referred to *Ovibos cavifrons* and credited to Dr. M. W. Dickeson, Natchez, Mississippi.

A last lower molar not yet cut and the roots are not developed. Crown 59 mm. high in front, 45 mm. high on hind lobe. 54 mm. long at the base, 43 mm. long at the summit. Anterior lobe 21 mm. thick at the base, 17 mm. thick just below the summit; middle lobe 19 mm. thick at base, 7 mm. at summit. On the inner face the columns and valleys are not so strongly developed as in *Bison*. On the outer face the two valleys are very deep and there are no accessory pillars.

In discussing the ontogenesis of the molars of *Ovibos moschatus*, Dr. J. A. Allen stated[10] that "the third molar breaks through the alveolus about the beginning of the fourth year." We may suppose that this was approximately the age of the

[6] Mem. Amer. Museum Nat. Hist., vol. IX, p. 203, pl. XXII.
[7] 12th Ann. Rept. U. S. Geol. Surv., 1891, p. 397.
[8] Geology, vol. III, p. 386, 1906.
[9] Publ. 322 Carnegie Instn. Wash., 1923, p. 393.
[10] Mem. Amer. Mus. Nat. Hist., New York, vol. I, pt. IV, p. 139.

possessor of the tooth of *Symbos* found at Natchez.—O. P. Hay, *Carnegie Institution of Washington, Washington, D. C.*

### CONVENIENT CONTAINERS FOR SPECIMEN MATERIAL

Often opportunities arise for the preservation of specimen material by treatment with formalin where containers are lacking or where such may be done by individuals not prepared to care for collections. In such cases, sections of old automobile inner tubes may be used, preferably not of exceptionally heavy rubber, and, of course, not badly deteriorated. These have proven very satisfactory in the preparation and shipment of fish specimens and should be equally satisfactory with small mammals or parts of specimens not easily crushed.

A section of a tube is cut about eight inches longer than sufficient to hold the specimen and one end fo ded back 1½ to 2 inches, rolled tightly and sealed by wrapping it several times with a rubber band formed by cutting off a section of the tube one inch wide. This forms a bag in which the specimen or material may be treated with formalin. The other end may be sealed in a similar manner or left open. After treatment the liquid may be drained off and with both ends sealed, a liquid-proof container results which retains the fumes of the preservative. The only precaution in treating is to avoid crowding in the tube so that the specimen may not harden in a distorted shape. For shipment it should be wrapped in corrugated board or similar material as an extra safeguard against any escape of moisture. Fish specimens treated this way have been shipped by parcel post across the continent very satisfactorily.—S. B. Locke, *Intermountain Forest and Range Experiment Station, Ogden, Utah.*

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# COMMENT AND NEWS

As this issue goes to press, word has been received that Dr. William Diller Matthew, Professor of Palaeontology in the University of California, died on September 24, 1930, at Berkeley, California.

Dr. Oliver Perry Hay, retired Associate of the Carnegie Institution of Washington, died on November 2, at the age of eighty-four.

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In view of the interest aroused in the proposed Everglades National Park in Florida, and the resulting discussion in regard to National Park policies at the New York meeting, it seemed desirable that the American Society of Mammalogists state its position as to the most desirable park treatment both of predatory animals, and of public roads. Accordingly the following resolution was adopted by the directors:

WHEREAS: The American Society of Mammalogists is vitally interested in our National Parks and the policies under which these are operated: be it

*Resolved:* That the American Society of Mammalogists is strongly in favor of maintaining all wild life in National Parks in its original status in so far as possible, and is opposed to the purposeful reduction of predatory and other animals, within National Parks, save in those rare cases where a superabundance of such predatory animals is actually threatening the maintenance of some particularly desirable species. Be it further

*Resolved:* That if beyond any doubt a reduction in the number of some predatory species within a National Park is imperative, such reduction be accomplished not by poisoning nor by trapping, but by shooting, this to be done only by Park rangers upon order of the Director of the National Park Service. And be it further

*Resolved:* That while the American Society of Mammalogists favors the building of roads within National Parks to a reasonable extent, it is opposed to any network system of roads therein, or any system that will tend to destroy desirable wild features of our parks through rendering all parts of them easily accessible to visitors.

Of the nineteen directors participating, but one voted against the entire resolution, two others objected to the part of the resolution pertaining to predatory mammals, and two more wished to qualify the last paragraph so as to indicate more clearly the opinion that while a reasonably adequate system of roadways is highly advisable, every national park should have extensive areas that are accessible by trail only.

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